May 19, 1921

Engineering News-Record

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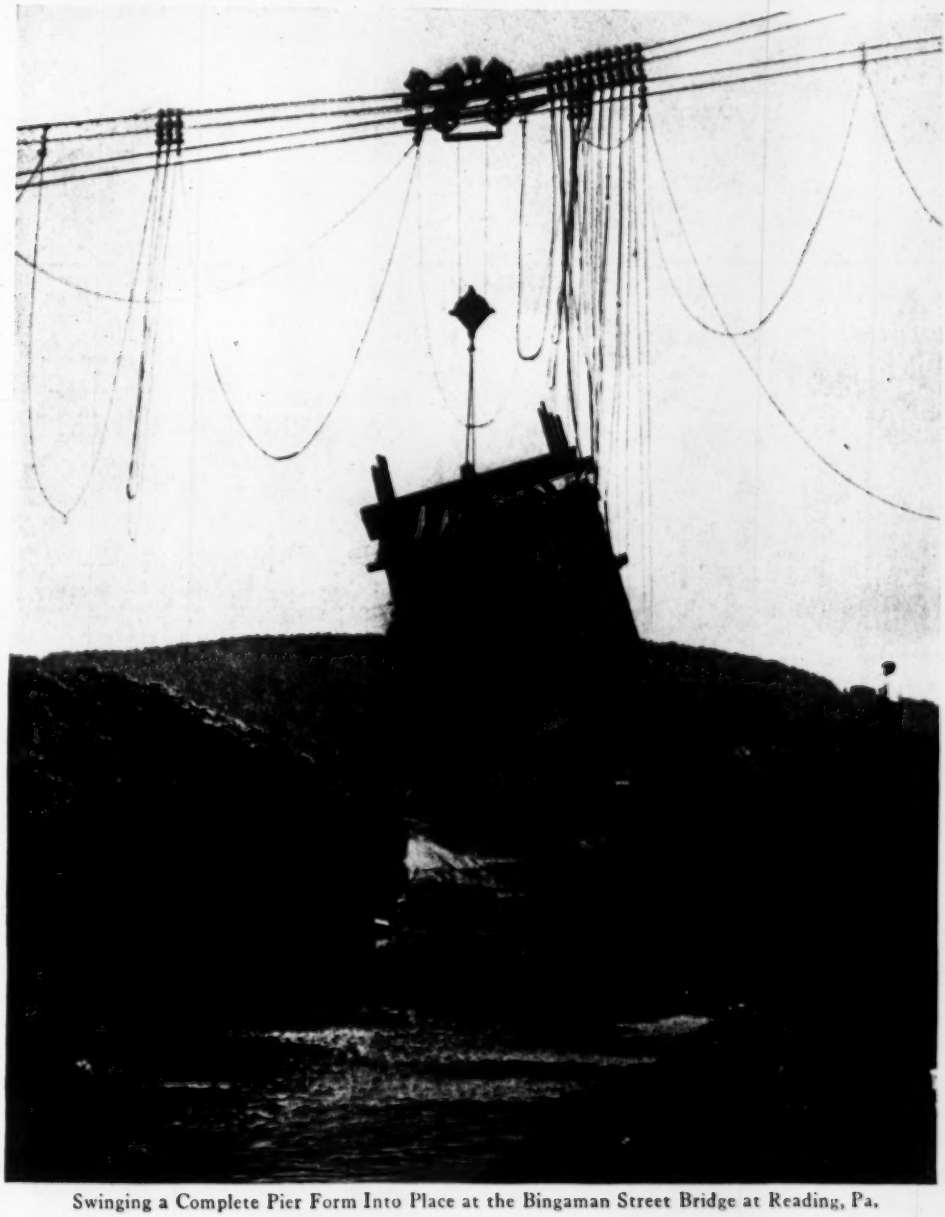


Swinging a Complete Pier Form Into Place at the Bingaman Street Bridge at Reading, Pa.

In this issue the main articles are on

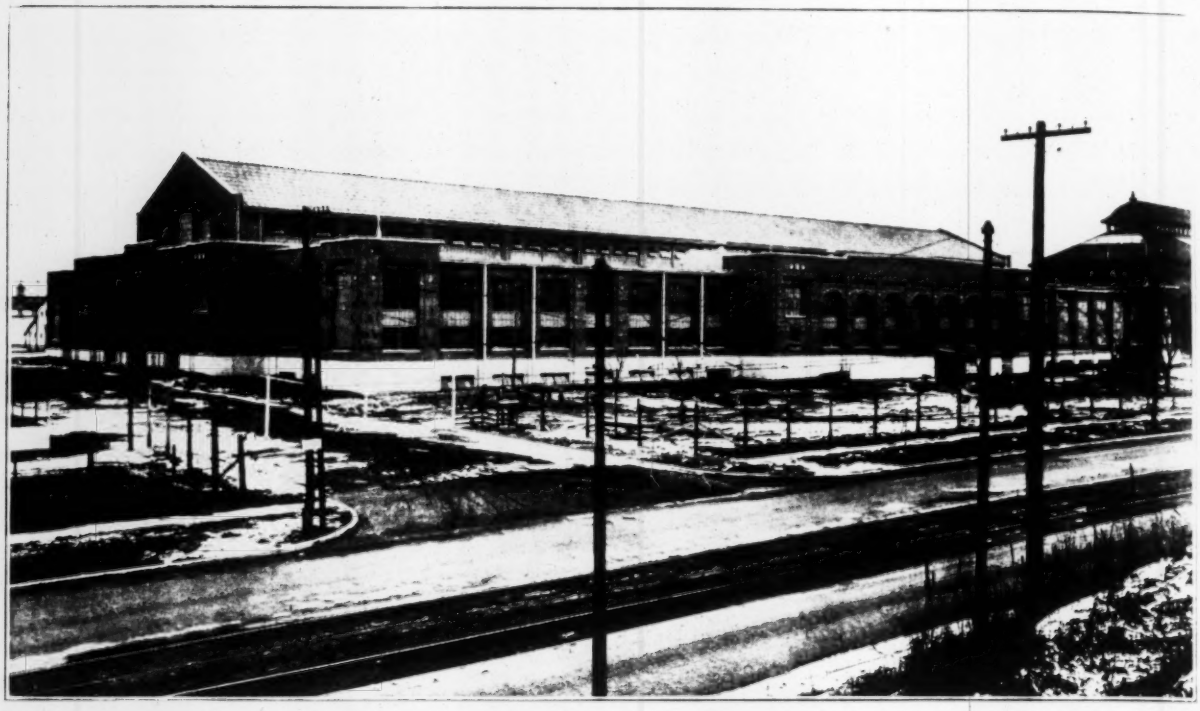
CONSTRUCTION · ROADS · CONTRACTING · WATER-SUPPLY

How a slag concrete bridge was built.

Reasons for failure of roadside gravel plants.

How a contractor keeps tab on his field forces.

How alum acts in water purification.



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*

Volume 86 — NEW YORK, THURSDAY, MAY 19, 1921 — Number 20

The A.A.E. Convention

THE present condition of the American Association of Engineers has been likened to that of a machine which has passed through the period of initial wear and is undergoing readjustment. This was apparent at the convention in Buffalo last week. The time was devoted mainly to constitutional revision and a discussion of chapter activities. The meeting made no contribution to the constructive work of the association. Its accomplishments must be measured solely by the progress in improving the internal mechanism. Apparently still more experimentation and adjustment will be necessary before stabilization can be expected. There is divergence of view regarding the functions and importance of headquarters as against the local chapters. The latter are now to get 60 per cent of the dues. At the same time doubt is expressed regarding thes afety of chapter autonomy by taking from some of them the right to collect dues. The results of its experiments should yield valuable lessons, for its practice is in sharp contrast with that of the older engineering societies.

The German Settlement

LAST WEEK'S acceptance by Germany of the reparations terms and of responsibility, without reservation, for carrying out the provisions of the Treaty of Versailles is the most important step in the peace of the world since the signing of the Armistice. If Germany takes her pledge seriously, it will remove the menace of world disintegration that has been hanging over us since Nov. 11, 1918. Our declaration that we would stand by our war allies was a big factor in bringing Germany to a decision. She had hoped that the United States would favor more moderate terms than had been offered. When we signified unmistakably that we would not do so her last hope for modification of the terms disappeared. Just what Germany can pay, no one, not even the cocksure French financial specialists, can determine. It is certain, however, that if she goes to work with a will the fair-minded people of England and of America, if not of France, will be inclined toward leniency if a day should come when it is unmistakably demonstrated that the last 64,000,000,000 gold marks, which may be considered a sort of third mortgage, cannot be paid without serious detriment to Germany's necessary financial and commercial relations with the rest of the world. The first step, however, in setting the whole world back toward peace was Germany's acceptance of the terms. She has now done so without reservation. We can only hope that her acceptance was sincere and that it will be followed by an earnest effort to carry out the terms of the agreement. That course is the only one that will insure for Germany ultimate restoration to a satisfactory place in the family of nations.

Interesting the Young Men

ONE of the most promising attempts that have come to our knowledge to interest the young men in engineering society work has been under way for more than a year in the Boston Society of Civil Engineers. It will be found described elsewhere in this issue. It proceeds on the very sound principles, first, that the subjects must be those in which young men have an interest because of their every-day contact with them in their professional work, and, second, that the young men are thoroughly capable of running their own show. We go entirely counter to human nature when we plead with the young men to come to society meetings which discuss engineering problems always from the standpoints of their elders. The elder men themselves would quickly desert a program designed always from the viewpoint of the juniors. The second, and possibly the strongest, feature of the Boston Society program, is the placing of the management of the Designers Section in the hands of the young men themselves. Young men are energetic and full of life. They want to do things. They want to exercise initiative. They are a little resentful of being placed in leading strings. The Boston society has wisely recognized these fine qualities of youth and has expressed its confidence in the young men by encouraging them to form their own section, run by themselves and for themselves. Obviously, they may need guidance from time to time. At Boston they have shown also that they *want* such guidance. They have asked the older men to come in as counselors, but the show is their own. As a result they have risen to the responsibility placed upon them and are doing a noteworthy work in interesting the young engineers. The two principles upon which this section of the Boston society is founded may well be taken to heart by engineering societies throughout the country. Youth is a tremendous asset. By and large we are not capitalizing it in our engineering societies. Boston has set us all a very good example. In saying that we do not want to belittle some good work that has been done with the younger engineers in other centers, but we do believe that the work at Boston is rather the most hopeful of which we have heard.

Canada's Railroads

THE PROPOSAL of Lord Shaughnessy, chairman of the Canadian Pacific, that the Canadian Government buy the lines of his corporation and then turn over the entire Canadian railroad system, excepting the Grand Trunk and a few small lines, to the Canadian Pacific for operation, injects a new and interesting consideration into the troubled Canadian railway situation. The Canadian Pacific has long been a thorn in the side of the Canadian government's handling of the railroad prob-

lem, not because of any fault of that railroad but rather because of its efficiency and the soundness of the business lines along which it has been developed. In contrast with it are the over-extended government-backed Canadian National and Grand Trunk Pacific systems, which have demanded rate assistance that would have meant great opulence for the privately backed competitor.

Lord Shaughnessy's proposal would at least remove the main controversial element in the Canadian situation. There would then be no question of giving large profits to one company in the effort to enable the others to barely keep afloat. The Canadian Pacific's skillful operating policy extended to the entire Canadian system would undoubtedly result in a fairly rapid reduction of the annual deficit which piles up on the present nationally owned lines, while the opportunities for further operating economies by the use of the most economical routes in the combined systems and the elimination of competitive service would result in further large savings. The danger in the situation lies in the fact that if the government made a compact now for private operation it might, in a few years, decide to assume the operation itself. If that should come Canada would have in its fulness all the evils of government operation of a huge business undertaking. Under present conditions, the people of Canada have constantly before them the example of an efficiently operated system which affords an excellent basis of comparison with the government operated lines. In saying this we are not losing sight of the fact that the nationally operated lines have not the heavy tonnage which make for low operating costs. If the details of the purchase agreement are made with fairness to the Canadian people, Lord Shaughnessy's proposal would seem to be advantageous to Canada, provided always that the operation be kept in the hands of the Canadian Pacific or an equally competent private organization.

Railroad Operating Costs

A DESPERATE situation confronts the railroads of the country. Operating costs must be reduced, if conclusions may be drawn from last week's proceedings at the Senate inquiry, in spite of the fact that net earnings reported for March show a substantial increase. Senator Cummins and Julius Kruttschnitt agreed that the railroads, in their present status, are "almost in death throes" and that reduction in operating expenses is vital. Almost at the same time, the "consulting economist" of the railway labor unions was charging that the carriers waste $2,500,000,000 annually, indicting the managements on counts impossible to sustain in whole, but partially based on actual opportunities for economy. Aside from the unions, it is generally agreed that the present railroad crisis, threatening to bring private ownership and operation, is due to a combination of lessened traffic with the burdens inherited from federal control.

However, the unions' charges should not be dismissed merely by saying that they are groundless. Most of them are. But some of them, even though exaggerated, are well founded, such as those with reference to terminal operation, freight handling methods, and loss and damage. Here the field is full of opportunities for those who are in possession of exact knowledge and the ability to apply it to problems heretofore solved by rule of thumb.

Many improvements that would result in economies cannot go forward because they require construction programs for which money is lacking. As a result the railroads' engineering departments have been reduced and their problems are not so much in new construction as in routine work and maintenance. Heretofore, railroad managements have too seldom called in their engineers in matters of operation. Is this not an opportunity for broadening the functions of engineering departments by applying exact knowledge to many of the intricacies of railroad operation long governed by custom?

However discouraging the present railroad outlook, there is good ground for hope that the bottom has been reached and that a way out will be found. The net operating income of the carriers for the month of March has just been reported as $30,894,065, following a deficit of $7,378,307 in February. Nevertheless the utmost effort is still needed to operate as economically as possible. The managements ask that less be paid to labor than required by the onerous national agreements. Regardless of the fact that most of the unions' charges of wastefulness are fallacious, the managements must also pledge good faith by leaving no stone unturned to reduce expenses on their own account.

A New Plan for Contracting

SEVERAL months ago, following the annual meeting of the Associated General Contractors in New Orleans, we commented upon the high vision with which the work of the association is being directed. There stood out strongly, backed by a wealth of ability, the determination to build for contractors a reputation for "skill, integrity, and responsibility" which should place contracting among the most honored occupations in the country. As was then emphasized in our editorial, the determination was not that of mere visionaries, but of men who have big accomplishments to their credit.

The events and tone of that January meeting in New Orleans were recalled in Washington Tuesday night of last week when the executive board of the association closed a two-day meeting with a dinner, at which the guests were prominent members of Congress and of the press. Half a dozen brief addresses were made by members of the executive board, with the purpose of picturing the magnitude, the work, the responsibility, and the obligations of the contracting industry. The inspiration of those addresses may be somewhat lost when they appear in cold type, but we hope that the association will print them, and in such form that they can be put in the hands of every contractor in the United States. We do not expect that every contractor every day will recall the picture that these addresses painted, but if he will occasionally revert to some of the thoughts they contain and gradually come to guide his business by the ideals therein expressed the whole contracting profession will take on a new atmosphere and a new place in the public mind.

The A. G. C. stands for "skill, integrity, and responsibility." If the men who are now directing its activities continue their interest and their support those principles will before long pervade the entire industry We do not mean that a wholesale conversion is to come about, or is, in fact, required. The good lies in the industry on all hands. What the A. G. C. is doing is to mobilize it—to mobilize it not only for the good of the industry but for the good of the public as well.

At the same time it is helping to bring the delinquents to the desirable plane. Eventually its work will draw a sharp line of demarcation between the able, upright and responsible contractors, on the one hand, and the disciples of the doctrine of "get by," on the other.

All of which is reason why both engineers and contractors should give their support to the A. G. C., the engineers with their influence and confidence, the contractors by getting into the A. G. C. fold both in fact and in spirit.

A Sweeping Sewage Disposal Decision

SECOND in importance only to the decision in the Chicago drainage canal case is that of the United States Supreme Court against all the contentions of the State of New York in its suit for an injunction against the discharge of sewage by the Passaic Valley Sewerage District into New York Harbor (see p. 849). The New York-New Jersey case is rated as second to the Chicago-St. Louis case, among other reasons, because the main issue in the earlier suit was the alleged menace to public water supplies, particularly the supply of St. Louis, by the sewage of Chicago, whereas in the New York-New Jersey case the water that will receive the sewage from the Passaic Valley communities is so brackish as not to be potable, regardless of pollution.

Two significant points in both the present and earlier decisions are: (1) That the complainants fell far short of proving their allegations; (2) that while there is no question as to the jurisdiction of the United States over the pollution of interstate waters, the federal government will not attempt to control the actions of one state at the instance of another unless a grave danger can be proved. The importance of these two points is increased by the fact that in both cases the court was unanimous. Moreover, since the fresh water of a great river used for municipal supply was concerned in the earlier case and the tidal, brackish, non-potable water of a great harbor in the latter, but with allegations of serious menace to public health in each, the two decisions may be regarded as of broad general application throughout the United States.

The verdict, "not proven," in each of these two cases should not lead other cities or groups of cities to think that they can discharge their sewage haphazard into the handiest stream or other body of water. Unquestionably, one may conclude from its reasoning, the United States Supreme Court would not hesitate to enjoin sewage discharge into interstate waters if menace to health could be proved. But the gap between allegations and proof of health menace and other serious nuisance is forcibly illustrated in each case. The wideness of this gap, and the difficulties of bridging it, would afford material for a monograph, but the subject must be passed by here.

Contrasted with the court's conclusion that there was lack of sufficient evidence to support the allegations of menace to New York City from Passaic Valley sewage is the weight the court gives to the investigations and opinions of the engineers on whose advice the Passaic Valley Sewerage Commissioners acted in adopting plans —and on which the Federal Government also acted in agreeing to the stipulations under which it withdrew from intervention in the New York-New Jersey suit. No stronger testimony to the wisdom of getting the best available technical advice before adopting plans for sewage disposal could be asked.

In the Chicago-St. Louis decision the court laid stress upon the fact that Missouri's case was weakened because that state allowed her own cities to discharge sewage into the river. In the Passaic Valley case just decided, there is no direct application against New York of the doctrine that a plaintiff must come into court with clean hands; but the court takes cognizance of the fact that New York City itself discharges into the harbor untreated sewage many times in volume the effluent from the proposed treatment works of the Passaic Valley and that between 1906 and 1919 the population increase of New York City and suburbs exceeded 100,000 a year, making a total about equal to the estimated population of the entire Passaic Valley Sewerage District in 1940. And yet the court concluded that instead of plain evidence as to 1919 harbor conditions there was a conflict in the "testimony of trustworthy and competent scientists."

By way of fatherly advice the court well says, in its decision, that more in the way of pollution prevention may be expected from co-operation than litigation. Whatever opinion may be held as to past attempts to obtain co-operation, a get-together spirit is certainly desirable in the future. Whether any advances may reasonably be expected from the New Jersey side until New York City adopts and begins to execute a construction program is at least open to argument.

Although without bearing upon the sane and sweeping character of the decision, it should be noted for the benefit of those not familiar with the thirty years' events since agitation for cleaning up the Passaic River began that the original plan was for a trunk sewer to Newark Bay, with the discharge of untreated sewage there. Events that cannot be reviewed in limited space led to the adoption of a plan to carry the sewage into New York Bay, with little treatment, and finally to plans for considerable treatment, with the possibility that still more may be required by the Federal Government. The original argument for a trunk sewer was that it would make treatment unnecessary and when the New Jersey Legislature prohibited the discharge of sewage into Newark Bay the tunnel to New York Bay was predicated on practically no treatment. Without questioning the wisdom of the engineers, who acted under strict limitations, or the judgment of the United States Supreme Court, which is simply ruling on allegations based on the plans as adopted, it is questionable whether if the Passaic Valley sewage problem were to come up *de novo*, thirty years after its first consideration, some more local means of disposal would not be recommended by competent engineers—at the very least, disposal, after treatment, into Newark Bay, thus avoiding the great and still problematical cost of the tunnel from the Newark Meadows to New York Harbor.

Taking the Passaic Valley decision in view of all the governing conditions, combined with the findings of the U. S. Army Engineers at the time of the hearing on granting a permit for the outlet in New York Bay, and the stipulations under which the United States withdrew from the suit, it may be said to give the sanction of the highest engineering and legal branches of the Federal Government to the general principle of sewage disposal by dilution, to the dissolved oxygen test as an index of pollution (at least for non-potable waters) and, last and not least, to the principle that no one state has a monopoly on the use of interstate waters for sewage disposal.

Long Arch Bridge Built of Slag Concrete

At Bingaman St. Bridge, Reading, Pa., Wedge-Shaped Piers Give Square Spans on Curve—Slag Aggregate Reduced Dead Load and Construction Costs—Twin Cableway Handled All Materials

By W. C. Fry, Jr.
Engineer, Whittaker, & Diehl, Contractors, Harrisburg, Pa.

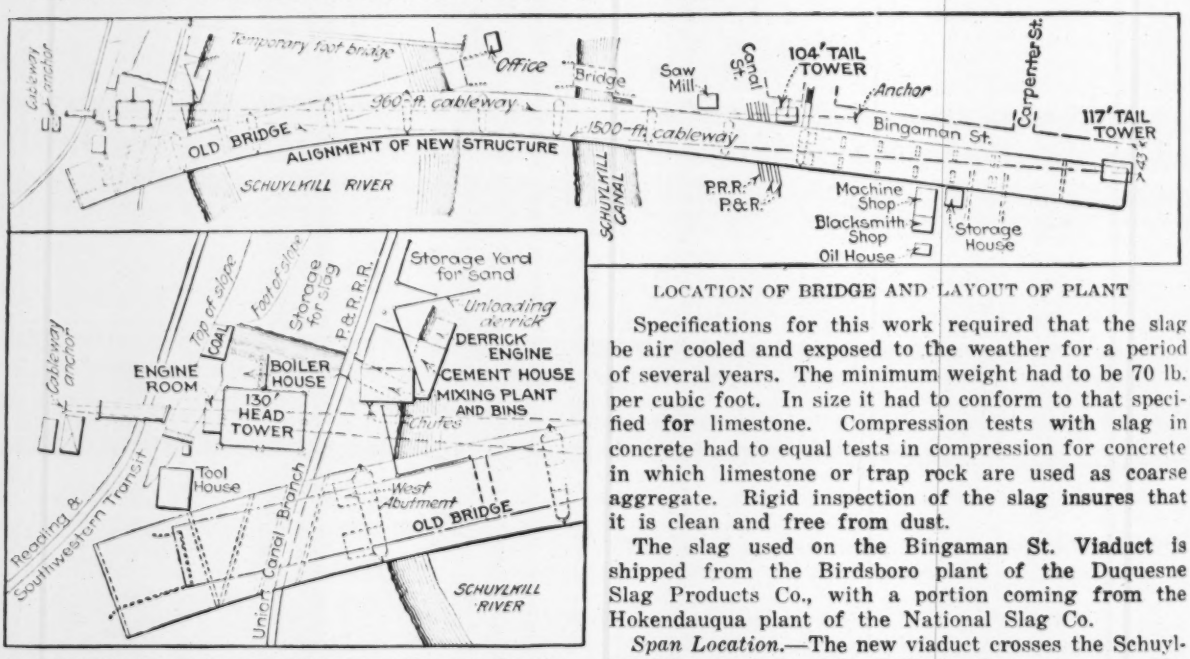
Slag concrete as a help to the contractor and span design studied to reduce formwork are outstanding construction features of the Bingaman St. Viaduct at Reading, Pa. The resulting advantages were a more workable concrete and very few sectional forms repeatedly used. All the facts are presented in the description which follows. In particular contractors will observe the evidence that slag concrete is more workable than concrete with a stone aggregate; there is less weight to be handled per unit volume of concrete and the mixture flows more readily through chutes and fills the forms with less labor. Incidentally it will be noted that this structure is probably the largest bridge ever constructed of slag concrete.—Editor.

One of the large concrete bridges of the United States, now in progress at Reading, Pa., is being constructed of slag concrete. Economy in design and construction is secured by the uncommon material. This object of cheapening construction was also sought by giving careful study to span lengths and locations and to arch design which would simplify formwork. As the result a 1,600-ft. bridge on a curve is being built at uncommon speed, with a few sets of arch centers and deck forms repeatedly used, and with a plant of which a twin cableway is the only large unit of equipment. The structure is known as the Bingaman St. Bridge and is being built for Berks County, Pa.

Slag Concrete.—Because of the uncertain transportation facilities and the materials situation at the time the specifications were written (1919) it was considered advisable to broaden the field of acceptable materials so as to permit the use of slag.

Comparative tests indicate that slag concrete is fully the equal of broken stone concrete. Several advantages are derived from its use. Slag concrete is about 15 per cent lighter, and since in reinforced-concrete designing the dead load is an important factor governing the design, slag concrete permits of slightly lighter sections with the same live load, resulting in a saving of concrete. From the contractor's viewpoint also slag has its advantages. It is lighter to handle, flows more readily in chutes, and requires less spading. Again, in this locality it is cheaper than stone, and as it is lighter than stone a ton of slag will yield a larger yardage of concrete. Moreover, this advantage in weight reduces the freight charge in transportation per unit of volume. These are points to be considered by the contractor in so large a job as the one described.

On the other hand, for the same amount of coarse aggregate, slag concrete requires slightly greater volumes of sand and cement to produce the same quality of concrete.

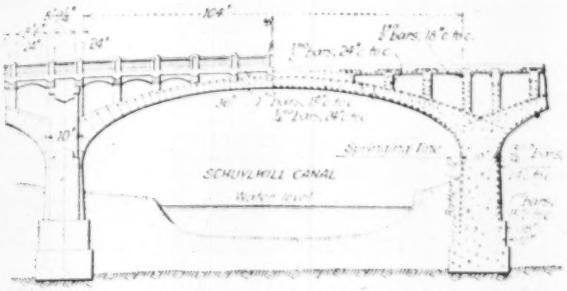


LOCATION OF BRIDGE AND LAYOUT OF PLANT

Specifications for this work required that the slag be air cooled and exposed to the weather for a period of several years. The minimum weight had to be 70 lb. per cubic foot. In size it had to conform to that specified for limestone. Compression tests with slag in concrete had to equal tests in compression for concrete in which limestone or trap rock are used as coarse aggregate. Rigid inspection of the slag insures that it is clean and free from dust.

The slag used on the Bingaman St. Viaduct is shipped from the Birdsboro plant of the Duquesne Slag Products Co., with a portion coming from the Hokendauqua plant of the National Slag Co.

Span Location.—The new viaduct crosses the Schuylkill River and the Schuylkill Canal, passing over the Union Canal Branch of the Philadelphia & Reading R.R., on the west bank of the river and a branch of the Pennsylvania R.R., on the east bank. In order to make the grade and pass over the tracks of the Pennsylvania R.R., giving a vertical clearance of 22 ft., the east approach of the bridge has a grade of 3.63 per cent, while the west approach has a grade of 2.43 per cent except for the last 60 ft., which descends on a 4.2 per cent grade.

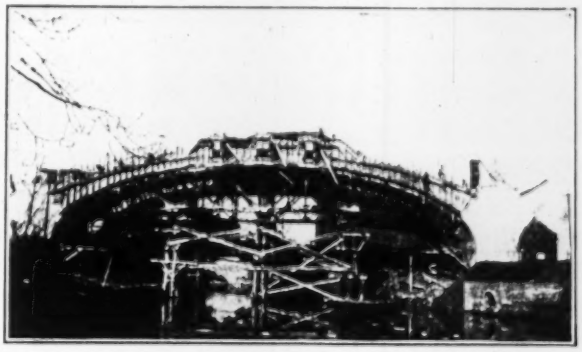


DETAILS OF 104-FT. SPAN OF BINGAMAN ST. BRIDGE

In determining the alignment and the spans of the arches many features governed. First the center line of Bingaman St., on the east side of the river, and the center line of Lancaster Ave., on the west side, which streets the bridge will connect, meet at an angle of 31° 3′ 15″ over the river channel, therefore the new bridge is tangent for about 800 ft. and on a 3° 48′ curve for 800 ft. So that the contractor could use steel arch centering advantageously it was desirable that the arches over the river be made uniform in span. To accomplish this it was necessary to consider the relative positions of the two railroads, the Schuylkill Canal and its towpath, Water St., and the river. To complicate matters the railroads on each bank of the river converged, crossing the proposed alignment at an angle of about 25 deg. In addition, the railroad tracks on Canal St., over which the bridge was to pass, are on a 10-deg. curve. In order to meet these conditions it became necessary to select by trial a span which would clear the Pennsylvania R.R., giving a minimum of 22 ft. vertical clearance; span the canal and its towpath without offering any obstruction; clear Water St., and then follow a 3° 48′ curve across the river, placing the abutment clear of the right-of-way of the P. & R. R.R. on the west bank. A span of 114 ft. seemed to meet these conditions. This span was then divided into clear arch span and pier width by arch and pier analysis according to the elastic theory.

Pier Design.—Calculations proved that with a rise of 20 ft., and with the loading for which the bridge was designed, a 104-ft. span arch and a pier width of 10 ft. were necessary. Having settled upon a pier width the next problem to be considered was how the increased length of the outer curve of the bridge over the inside curve of the bridge could be taken care of. This difference amounted to 3 ft. 8 in. in 114 ft. of alignment; that is the difference in distance between the north ends of the center lines of the two successive piers and the south ends of the same piers was 3 ft. 8 in., the center lines of the piers being radial lines of the curve. This difference in distance was thrown into the piers themselves, making them wedge-shaped, and permitting a clear arch span of 104 ft. both on the outside and on the inside of the curve of the bridge.

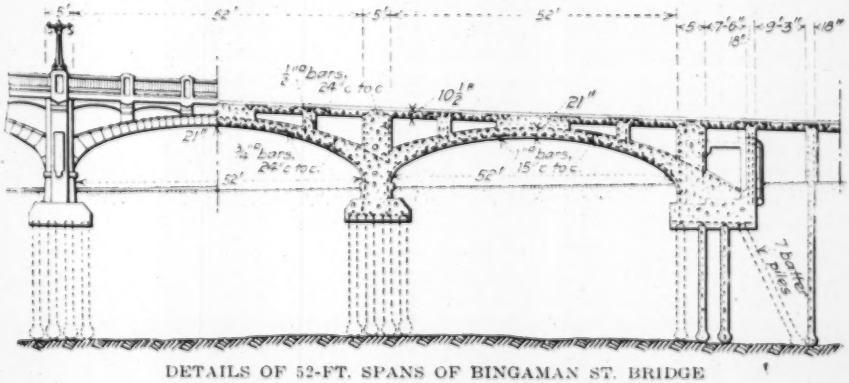
The wedge-shaped piers were no more difficult nor expensive to construct than rectangular piers; on the contrary the construction and certain features of design were considerably simplified. This design permitted the steel centers for the arches to be interchanged, and to be shifted laterally, either up or down stream, after they had been lowered upon rollers. This was a distinct advantage, inasmuch as in the case of three spans it was necessary to move the centers out from under the arch northward, while in one case, on the curved portion of the bridge it was found advantageous to roll the centering southward from under the arch.



FALSEWORK AND CENTER FOR 104-FT. SPAN

Another advantage resulting from this method of taking care of the curvature of the bridge is that it permitted the building of rectangular sectional forms for the floor slab and interchangeable sectional forms for the panel railing.

Again, had it been found economical to build one rib at a time this design would have permitted the contractor to pour one rib, and at the proper time lower the centers and shift them laterally into position under the proposed location of the second rib. This would not have been possible on the curve if the piers were rectangular. This possibility was not taken advantage of, as it was decided that more rapid progress could be made if the two ribs were placed simultaneously.

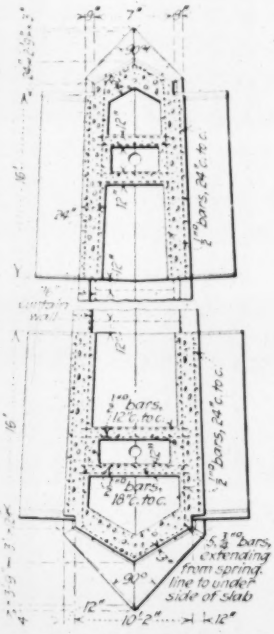


DETAILS OF 52-FT. SPANS OF BINGAMAN ST. BRIDGE

Arch Design.—The design of the arches is consistently the same; they are two-ribbed, open-spandrel arches, each rib being 16 ft. wide with a clear space of 16 ft. between them. The floor slab is carried on beams resting on 2-ft. spandrels 10 ft. 6 in. center to center. Expansion joints in the floor slab are provided at each pier. On the curved portion of the viaduct the floor system follows a true curve, while the arches are chords of the curve. The sidewalks are carried on

heavy beams cantilevered 6 ft. beyond the outside faces of the ribs. This was done with a view to economy, shortening the length of the piers, which are solid only in the line of the ribs, and also thus providing a means of taking care of the curved alignment. Between the ribs and below the springing line the solid pier sections are connected by roofed 18-in. curtain walls, giving the appearance of solid piers below the springing line.

Railing Design. — The railing and posts, which will be composed of one part portland cement, two parts sand, and three parts granolithic grit will consist of a heavy top and a bottom rail with specially designed spindles. The rails will project into the posts 3 in., resting in a pocket provided in the posts. The rails will thus be entirely separated from the posts, permitting true expansion. The posts are cast first, and later when these have thoroughly set the rails and spindles may be cast.



SECTIONAL PLAN OF PIER FOR 104-FT. SPAN

The total width of the bridge is 60 ft., divided into two 10-ft. 6-in. sidewalks and a 39-ft. roadway. Two hundred feet of the eastern approach is beam and slab construction carried on columns, closed in on each side by an 18-in. curtain wall. Following this are five 52-ft. span elliptical arches with 5-ft. piers, eight 104-ft. elliptical arches with 10-ft. piers, and 160 ft. of beam and slab construction carried on light piers and columns where the bridge passes over the P. & R. R.R. tracks.

Loads and Stresses.—The bridge was designed to carry the following live-loads: Sidewalk, uniform live-load of 100 lb. per square foot.; roadway, two electric lines with 50 ton electric cars, together with a uniform live-load of 200 lb. per square foot over the remaining area of roadway. The load on each car track was assumed to be distributed over a width of 9 ft. The maximum allowable stresses in design were compression 550 lb. per square inch, tension in steel 16,000 lb. per square inch.

The above detail information relative to the design was procured from Charles F. Sanders, the designing engineer, who also has supervision of construction.

A rather elaborate plant layout has proved economical. A careful study of the site proved the necessity of a cableway and since the alignment is partly on tangent and partly on curve, in order to make a cableway practicable and serviceable it was necessary to use twin cables. Even the two cableways do not serve the entire job, for the western end for 200 ft. is without its service.

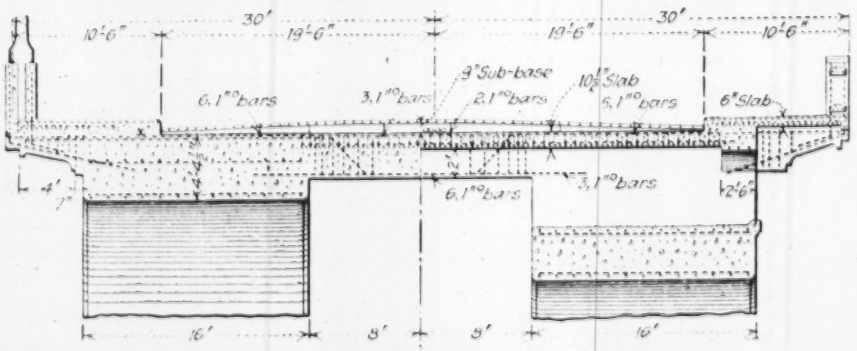
A single-head tower 130 ft. high, with a base 52 x 34 ft., has been erected on the western bank of the river about 60 ft. from the center line of the bridge. This tower is framed of 12 x 12-in. timbers 24 to 32 ft. long as posts, or legs, and braced with 4 x 12's, making a total of approximately 28,000 ft. of lumber. The tower was so designed that the resultant loads on the tower pass down the front legs, which have a batter of 3 on 1. The legs rest on sills which are supported on eight cinder-concrete bases. On the rear of the tower and elevated about 20 ft. above the base is the engine room. From this elevated position the enginemen command a good view of almost the entire job. The boiler room is directly below the engine room.

The two cables, one of 2-in. plow steel, with a span of 960 ft., the other 2¼-in. plow steel, with a 1,500-ft. span, pass over this head tower about 10 ft. apart, resting on a head block fastened rigidly to the tower. Making an angle of about 45 deg. with a vertical, they pass down from the head block and are anchored to a 20-in. oak log 18 ft. long which is concreted in a pit below the ground surface.

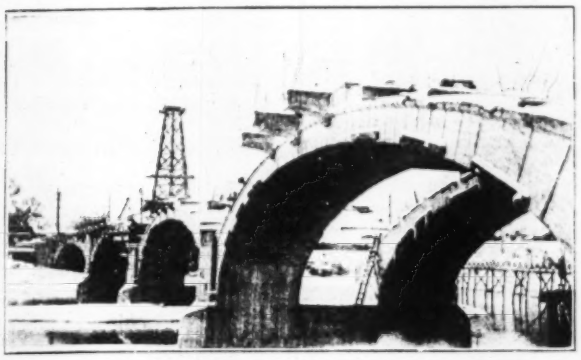
Two tail towers are necessary, one 104 ft. high at the end of the 960-ft. span, and the other at the end of the 1,500-ft. span, 117 ft. high. The cables diverge from 10 ft. at the head tower to 48 ft. at the end of the 960-ft. span. Behind each tail tower the cable is anchored to an oak log concreted in a pit.

While the erection of the three towers and the suspending and anchoring of the cables were a slow and costly operation, the cableways have proved to be an economical investment. Had the alignment of the bridge been such that one cableway would have served the entire job it would have been a mistake to have erected only one. There is rarely a time when the two cables are not in operation. Without them it would been difficult to move the steel arch centering for the 104-ft. spans.

There is one central mixing plant located about 50 ft. from the head tower, just off the line of the cableways. This plant comprises a pair of one-yard mixers, each with a capacity of 25 cu.yd. per hour. Directly above the mixers are storage bins with a capacity of approximately 200 cu.yd. of coarse aggregate and 100 cu.yd. of sand. In the rear of the mixer is the cement house, capable of taking ten cars of cement. A track running alongside the cement house permits rapid unloading. The sacks, picked up by hand, are carried to the door of the car and there dropped onto a belt conveyor which elevates and carries them to various



TRANSVERSE SECTION OF TYPICAL SPAN



COMPLETED RIBS FOR ARCH SPANS

parts of the cement house. Directly back of this cement house is a large unloading derrick, with an 85-ft. boom, equipped with a clamshell, the storage yards being located around it.

When concrete is being placed the concrete buckets are lowered from the cableways into a shallow pit in front of the mixing plant; from the mixers the concrete runs down a chute and thence into the buckets, which are of the drop-bottom type with a capacity of 48 cubic feet.

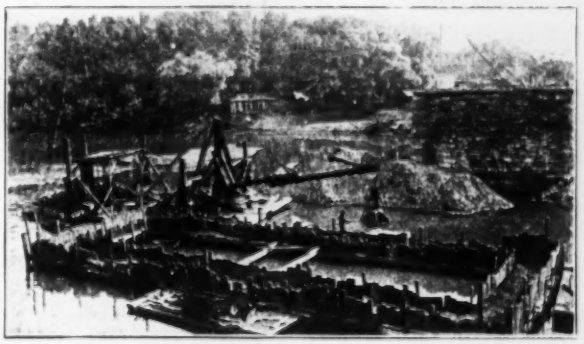
A completely equipped machine shop, a blacksmith shop, and a sawmill are indispensable parts of the plant. In the sawmill many sectional forms are built directly beneath the cableway, from which point they are picked up when complete and carried by the cableway to the place for which they have been built. Large sectional forms 50 x 12 x 12 ft., to be used for pier forms from footing to springing line, have been built at the sawmill in three sections and later carried out and placed carefully on the footings made to receive them. This method proved economical, since these forms were used over and over again.

Pier Construction.—The footings of all the large piers and abutments rest on good shale. All the river piers were built within a double dam, which was pumped dry before any excavation within it was made. The river in the line of the bridge averages about 6 ft. deep, with a bed of several feet of coal dirt or culm washed down from the Schuylkill coal districts, about 35 miles north of Reading. The practice in the construction of these dams was to frame the bracing for the dam along the bank of the river and then float this framework to its proper location surrounding the proposed site of the pier. The bed of the stream at this site was previously clamshelled from a derrick boat until the culm had been entirely removed and the gravel bottom exposed. Upon this gravel bottom the cofferdam framework was placed. Three-inch T. & G. sheathing was then driven about the double dam. The space between the two lines of sheathing, about 6 ft., was then filled with clay, which in some cases was puddled and packed tight by dropping a 2,000-lb. hammer into the clay. This method proved effective and very little pumping was required to keep the dams dry. After pumping out the water the interior was clamshelled out until rock was exposed upon which the concrete footings were placed.

In the case of the piers for the small arches it was considered economical by the designing engineer to rest the footings on 16-in. concrete piles, cast in place and driven to rock. In all a total of 408 piles were required. In the case of the east abutment 14 batter piles were driven at an angle of 25 deg. to the vertical to help balance the horizontal shear in the abutment.

Arch Centering.—The steel arch centers for the 104-spans weigh 43 tons per span. The contractor was required to provide centering for at least three contiguous spans, but the centers of the last arch constructed could not be lowered until the next two succeeding arches had been turned and properly keyed upon their centers.

The centers for each arch, consist of two 97-ft. steel trusses, on 9-ft. 2-in. centers, under each of the two ribs. These trusses are rigidly braced to one another and supported at five points on timber piling driven to resistance. Each pair of trusses is made up of six different units bolted together. Each unit with its 2-in. lagging attached is light enough to be readily picked up with the cableways. The operation of lowering and moving the centers ahead is simple. After



COFFERDAM AND EXCAVATING EQUIPMENT ON ONE OF THE RIVER PIERS

drawing the oak wedges and allowing the centers to be lowered upon 8-in. wooden rollers the steel trusses are rolled out laterally from beneath the concrete arches on timbering previously erected until the centers are entirely clear of the arch. The trusses are then separated into their six units, and one unit at a time, with the lagging and joists still in place, is raised and moved by the cableway to the third span ahead, where it is lowered into place on piling and bents previously erected to receive it. The heaviest section, with its joists and lagging, weighs about 6½ tons.

The problem of pulling the piling after the removal of the steel centers was a difficult one. Many of the piles were driven to quite a depth and pulling them was no easy task. It was impossible to draw them directly with the unsupported boom of the derrick boat. Finally a simple A-frame was built with two five-sheave blocks suspended. This A-frame, carried on the end of the boom of the derrick boat, was swung around over the pile, lowered by its side until it rested on the bed of the stream, and then with the aid of the hoisting engine on the derrick boat the pile was readily drawn.

Progress.—The bridge when completed will contain approximately 21,000 cu.yd. of concrete, and 500 tons of reinforcing steel. On May 1, 1921, 11 months after the placing of the first yard of concrete, 16,000 cu.yd. had been poured, an average of more than 1 460 cu.yd. per month, with a maximum monthly pouring of 2,100 cu.yd. and a maximum weekly output of 960

cu.yd. The plant is equipped to place concrete in the coldest weather, steam jets being run through the sand and the slag piles, and a steam coil through the water tank. The recent winter having been rather mild excellent headway was made. The contracted time within which the bridge is to be completed is 400 working days. Considering the fact that some time was lost last summer because of the irregular shipments of cement the progress has been satisfactory.

The work is being carried out by Whittaker & Diehl, of Harrisburg, Pa., under the superintendency of I. J. Reighter. The total cost of the bridge including street improvements and property damages will exceed one million dollars.

Residual Aluminum Compounds in Filter Effluents

New Conceptions of Chemical Reactions Based on Recent Developments in Chemical Field

IN A number of respects orthodox conceptions of the action of alum in water seem to require some modification and extension. Such changes in viewpoint may be particularly desirable at this time, when discussion in water-works fields has again reverted to the problem of residual alumina in filter effluents. For this reason Abel Wolman, division engineer, Maryland State Department of Health, and Frank Hannan, Toronto Water Filtration Plant, have considered it a fruitful task to attempt in *Chemical and Metallurgical Engineering*, April 27, 1921, p. 728, to develop an understanding of the mode of action of alum as a coagulant. In such a development the causes of certain associated phenomena, such as disappearance of floc, positive reaction for alumina in filter effluents and imperfect coagulation with low alkalinity, may also appear. In the discussion, of which the following is an abstract prepared by Mr. Wolman, the passage, through filters, of undecomposed aluminum sulphate due to insufficient alkalinity or of flocculated hydrate through breaks in filter beds is not under consideration. In other words the discussion refers to difficulties inherent in natural processes and not to those resulting from unintelligent application of chemicals or operation.

Aluminum Sulphate Reactions

Usual Conception—The general conception of the reaction of aluminum sulphate with the natural alkalinity of water is given by the following typical equation:

$$Al_2(SO_4)_3 + 3CaCO_3H_2CO_3 = 2Al(OH)_3 + 3CaSO_4 + 6CO_2$$

or

$$Al^{+++} + 3HCO_3 = Al(OH)_3 + 3CO_2$$

This rigid transformation is usually accepted as approaching the average state of affairs when "normal" conditions obtain. The simplicity of the reaction has been so frequently emphasized that the impression has been gained that, when the coagulum, $Al(OH)_3$, is not instantly and continually formed the treatment is either careless or faulty.

It is probable that ineffective floc formation and residual alumina in filter effluents, even with plenty of raw water alkalinity, is due to causes other than poor control. When a study of alum reactions is undertaken two important hypotheses appear, which are in conflict as to the nature of the compounds resulting from such reactions. They are, however, in complete agreement as to the absence of rigidity of state of any particular aluminum compound. From this viewpoint the formation of an insoluble coagulum, as $Al(OH)_3$, becomes a desirability but not necessarily an eventuality. The problem becomes one of determining those factors which regulate the reactions in such manner that the desired result, an insoluble complete coagulum $Al(OH)_3$, is obtainable.

Recent Interpretations — The important characteristic of recent conceptions of $Al_2(SO_4)_3$ reactions is to be found in the realization that the formation of $Al(OH)_3$ is a reversible progressive reaction dependent upon a number of conditions, the most important of which is probably the hydrogen-ion concentration or P_H value of the solution with which one is working. The nature of the solutions obtained when $Al(OH)_3$ is dissolved in the presence of acids or bases has been the subject of much discussion. The underlying hypotheses of these discussions may be divided into two classes. In the first case the solution of $Al(OH)_3$ is ascribed to processes of peptisation or change in physical structure of $Al(OH)_3$, but not change in chemical composition. The second school of thought bases its understanding of the processes entirely upon the hypothesis that the changes taking place when $Al(OH)_3$ is formed and redissolved are due to variations in chemical combination. The contrasting viewpoints emphasize changes in physical state as against changes in chemical combination. The salient features of each conception are outlined at some length in the original paper in order to demonstrate that, whatever viewpoint is accepted, one must reach the conclusion that the complete formation of the insoluble $Al(OH)_3$ in water is by no means as frequent an accomplishment as it has been tacitly assumed to be.

It is well to emphasize the ephemeral character of the insoluble $Al(OH)_3$, whose re-solution may be due to a change in its physical structure (peptisation) or to chemical changes. Whatever the nature of these changes, it is clear that they are predicated upon some effect of hydroxyl or hydrogen ions. For the particular subject with which we are now concerned, experiments are taken from the literature which demonstrate beautifully that the amount of $Al(OH)_3$ held in a given alkaline solution is *a function of the alkalinity of the solution.* This conclusion cannot be stressed too greatly, since it appears to the writers to be the basis of a better understanding of the mechanism of alum coagulation.

It is pointed out that in the case of amphoteric hydroxides, such as $Al(OH)_3$, an excess of base is to be avoided. It becomes desirable, therefore, to select that degree of alkalinity which will insure most nearly complete precipitation and at the same time avoid re-solution of the precipitate. Certain data are presented from the experiments of other workers which show quantitatively that the precipitation of alminum hydroxide by ammonium hydroxide is complete when the P_H of the solution is between 6.5 and 7.5. What is this point of optimum precipitation in our water supplies? Have we ever paid any attention to it? We must expect certainly that there are numerous points in coagulation in which re-solution of $Al(OH)_3$ is always taking place. The occurrence of aluminum compounds in filter effluents should be as common as it is now considered rare. Chance, and not mischance, in the past seems to account for its failure to appear.

Practical Application to Water Problem—Aluminum compounds may exist in three states, defined by their hydrogen-ion concentration, as (1) non-ionogenic or isoelectric $Al(OH)_3$, (2) metal aluminate, eg., *Na* or *Ca* aluminate, and (3) alumino-acid salts, e.g., aluminum chloride, aluminum sulphate, etc. Thus, in practically every water treated with alum, at any point other than the isoelectric point (which has not yet been determined for varying waters), an equilibrium may exist between hydrogen ions, metal aluminates and non-ionogenic or isoelectric $Al(OH)_3$. (If the P_H were lower than the isoelectric the Al ion would replace the aluminate. In water practice, however, such cases would be rare.) It is reasonable to suppose that, just as often as not, the P_H of a water is not correct to permit the complete formation of $Al(OH)_3$ only. For this reason the occurrence of other aluminum compounds should not surprise one in filter effluents, for such compounds are soluble and need not be removed by the sand.

At this point, also, it is important to suggest that *not only low alkalinity may be fraught with danger but too high hydroxyl-ion concentration may not be so desirable* for

proper and successful coagulation and for the complete elimination of soluble aluminum compounds. It seems, as a preliminary theory, that as one departs from the point or area of favorable hydrogen-ion concentration, in coagulation processes, one passes, in either alkaline or acid direction, into fields of re-solution of aluminum hydroxide. This conception, it is clear, is independent of the causes of such re-solution. It is important, therefore, to keep in mind the ever-present possibility of missing the favorable threshold area of coagulation and passing into the unfavorable dissolution areas.

Does the literature of water purification disclose any data in confirmation of the above hypothesis of equilibrium conditions of alum reactions? It should be difficult to obtain such material, since it is only recently that determinations of hydrogen-ion concentration have been made in water. Hitherto only potential alkalinity and acidity have been determined because of current methods of titration, while actual alkalinity or P_H values have remained unknown. It is these latter conditions which are usually operative in conditioning our water supply reactions. Preliminary experiments are described in which it is demonstrated that the alteration of P_H conditions by acidification of a water of too high alkalinity results in more complete precipitation of $Al(OH)_3$, more successful filtration and elimination of alumina from filtrates. Variations of these laboratory experiments lead to the same conclusions as indicated above. It is easy to see why this fact of optimum P_H for precipitation has escaped observation. We have always been told that deficiency of alkalinity was the thing to be avoided. No one would be likely to try adding acid.

Conclusions—Theoretical considerations, supported by experimental results obtained in water work and elsewhere, appear to demonstrate fairly completely that the reaction of aluminum sulphate with the natural alkalinity of a water is a complex mobile transformation. The reaction seems to be delicately dependent upon the actual alkalinity of a water, its hydrogen-ion concentration, rather than upon its potential alkalinity. The hydrogen-ion concentration in turn is regulated to a large degree by carbon dioxide equilibria. Evidence so far accumulated seems to indicate that complete precipitation of $Al(OH)_3$ takes place at a hydrogen-ion concentration somewhere near the neutral point, P_H 7.0, unless disturbing or buffer influences are operative. Outside of this zone of favorable alkalinity re-solution of insoluble floc occurs to a greater or less degree.

It seems clear from the above considerations that the appearance of aluminum compounds in filter effluents should not be accepted as due to faulty operation, according to orthodox interpretations, but to failures due to misunderstanding of the reactions involved. This statement is given in the nature of an hypohesis to be substantiated by further experimental evidence. If the hypothesis is found to be true, the problem of residual alumnia, not only in filter effluents, but in all coagulated waters, may be attacked from a new angle.

The writers have studiously voided any reference to the sanitary, physiological or economic importance of the passage of soluble aluminum compounds through filters. That the phenomenon has a great practical importance, however, the little data we now have apparently confirm.

Proposed Improvement of Chicago Railway Terminals

Intensive Development of New Site Air Rights—Would Abandon Old Facilities, Straighten River and Open New Streets

RAILROAD TERMINAL improvements, south of the Chicago Loop District, including the straightening of the Chicago River and intensive development by erecting high buildings over the new freight houses, are outlined in a recent report submitted to the mayor and city council by John F. Wallace, chairman of the Chicago Railway Terminal Commission. This report marks the closing of Mr. Wallace's services in connection with this work, as he has resigned from the commission.

The southern terminal area, in which are grouped the terminal facilities of fourteen railways, presents the most complicated problem of any part of the Chicago railway terminal system, since it includes a large area of railway property which is of high value but has only low-grade occupancy. This area not only forms an obstruction to the natural development of the city but also interferes seriously with street traffic between the central district and the southern part of the city. Its real estate value alone is considered too great to justify its continued use for railway purposes exclusively.

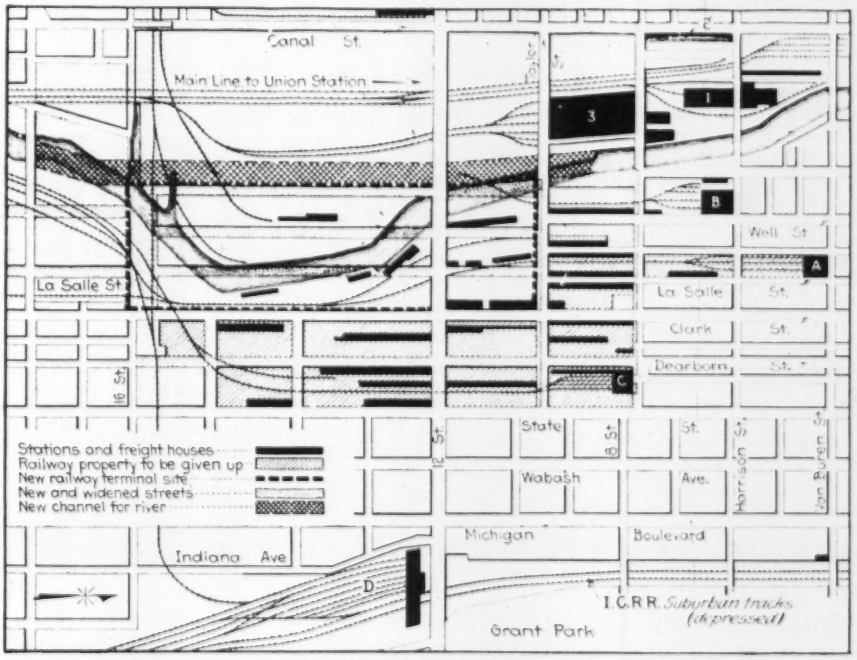


FIG. 1. CHICAGO RAILWAY TERMINAL REVISION

Passenger stations: A, LaSalle; B, Grand Central; C, Dearborn; D, Illinois Central (new). Freight stations (new): 1, Chicago & Alton; 2, Chicago, Burlington & Quincy; 3, Pennsylvania.

In the western terminal area along the west bank of the river and the eastern area along the lake front, the terminal facilities are being reconstructed in accordance with the ordinances for the new Union station and for the new Illinois Central R. R. station and lake front development. The terminal areas along the north bank of the river and the west bank of the North Branch do not offer serious interference with street traffic to and from the central business district.

Obstruction to traffic and commercial development in the southern terminal district has been a source of complaint for several years. An eastward loop of the river cuts off some of the north and south streets and others are blocked by railway property, so that there are only four thoroughfares and one of these is a boulevard from which commercial traffic is excluded. Much of the railway property consists of open yards and one-story freight houses, but although the land is potentially of great value the railways have been reluctant to consider relinquishing it owing to the lack of suitable alternative sites and the cost of reconstruction. Both of these objections are considered to have been overcome by the present project, which is shown in the map, Fig. 1.

Property adjacent to the river is cut up in an awkward and uneconomical manner by the loop in the river, but by building a new channel as a chord to the present arc, there will be made available a site convenient and sufficient for all the railway facilities now grouped between Clark St. and State St., besides affording opportunity for opening four new thoroughfares to the south side. The ground elevation would be lowered to 5 ft. above water level, so that the streets could be carried over the site on viaducts and thus leave practically the entire area available for railway purposes. This arrangement will provide for double-deck terminals, having the team floors at the street level and all tracks at the lower level. Above the freight houses, the air rights might be developed by the erection of buildings for commercial purposes. Inclined approaches would connect with existing streets at the lower elevation. This double-deck arrangement is considered impracticable on the present site, as it would necessitate the raising of the grade of State St. and adjacent property, involving enormous expense.

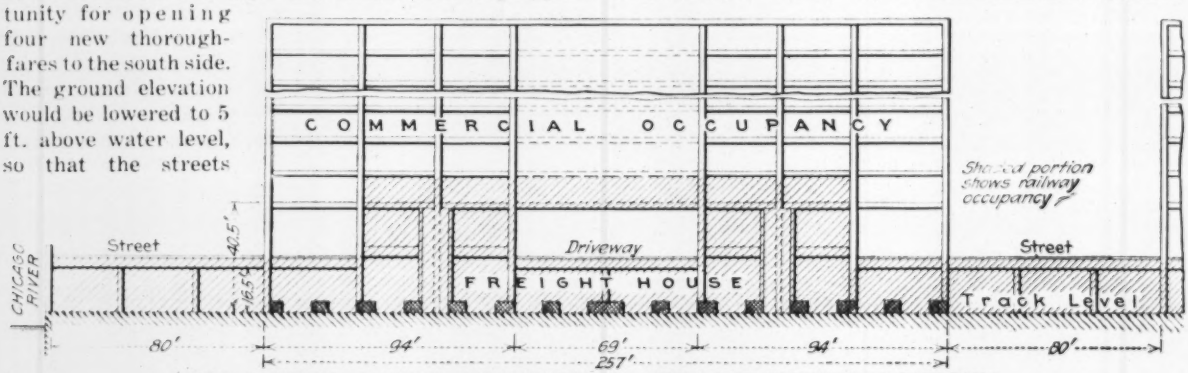


FIG. 2. FREIGHT HOUSE SURMOUNTED BY OFFICE OR INDUSTRIAL BUILDING

Removal of three passenger terminals is included in the project: the LaSalle station of the New York Central and the Rock Island Lines; the Grank Central station and the Dearborn station, the two latter being old structures used by groups of railways. The LaSalle station is large and modern, and borders on the loop district. It is proposed to transfer the business of these three stations to the large new station which is to be built on the lake front at 12th St. by the Illinois Central R.R., as provided by an ordinance passed last year and accepted by the railway company (see *Engineering News-Record* of July 31 and Aug. 21, 1919, pp. 216 and 360). Land at this site is very much cheaper than that at the present stations.

An advantage to the railways in thus concentrating at the lake front site, in addition to the release of their own more valuable property, would be the avoidance of electrification on the numerous lines to the present stations. It is true that plans have been made for reconstruction of the Dearborn station on a large scale, but in view of the public demand for electrification it is reasonably certain that this would be made a requirement for any permit for improvements. With this arrangement carried out, all the main-line passenger traffic would be concentrated at three large terminal stations: the Chicago & Northwestern Ry. station, northwest of the business district; the Union station on the west side, and the Illinois Central R.R. station in the southeast. A suburban station for all lines from the south is planned on the site of the present LaSalle station, on the south side of the loop, and the Illinois Central R.R. already has a separate suburban terminal at Randolph St., near the northeast corner of the loop.

In straightening the river there would be practically no disadvantage to offset the great advantages. The new channel would be cut almost entirely through railway property, and though it would necessitate some trackage rearrangement on the west side it would give a new and commodious site for terminals and remunerative commercial development on the east side as noted above. Railways owning 50 per cent of the new frontage have agreed to co-operate in the river straightening. As the new channel would improve navigation it is not likely that any objection would be made by the U. S. Government, although the Government would not undertake this work, since it is essentially a municipal improvement. There are contrary opinions as to whether the city now has power to change the river channel, so a bill has been introduced in the Illinois legislature to permit cities to undertake such work when required for public improvements.

As to the important question of cost, it is estimated that sale of the present high value property occupied would more than cover the cost of reconstruction on the new site and that sale of air rights above this site would make an attractive investment. The combined project of river straightening and terminal improvement has been under consideration for several years and has been discussed by representatives of the city and the railways. Problems of site and cost have been a difficulty, as noted above, but the air development is a new feature which changes the conditions materially and is believed to make the removal a matter of economy rather than of expense.

In this respect the project follows along the line already taken by the New York Central R.R. in intensive development over the site of its New York terminal, as described fully in *Engineering News-Record* of Sept. 9, 1920, p. 496. The possibilities of air development at Chicago are shown by Fig. 2, which represents one of

the freight houses and in which the shaded area shows the portion that would be used for railroad occupancy of two or three stories. Around and above this is the structure available for commercial purposes, offices and warehouses.

A special feature of this arrangement is that the railway facilities are provided with a separate driveway, so that the commercial occupancy would have a street frontage independent of the railway. This separation of railway and commercial occupancy is an important feature which is not embodied in any of the existing two-level freight houses at Chicago. Construction and management of the commercial portion of the structure might be undertaken by private interests in co-operation with the railway companies, whose charters would not permit of their undertaking an enterprise of this character.

The construction cost of the new terminals is estimated at $43,000,000, of which $20,000,000 would be paid by the city. This is distributed as follows: straightening the river and altering bridges and tracks, $3,000,000; viaducts and street connections, $17,000,000; railway facilities, freight houses, track changes and suburban station, $23,000,000. Railway property released would be 3,000,000 sq.ft., valued at $20, or $60,000,000. Air rights on the new site are estimated at $10 per square foot, or $25,000,000, so that the return from these or interest therefrom should be sufficient to finance the $23,000,000, which is the railway share of the expense. Therefore, the railways would secure a new site of the same area as that relinquished, with double the present car capacity and an investment of $85,000,000. Ten-story buildings over the railway freight houses are estimated to cost a total of $95,000,000, which would be provided by private capital.

The investigations and plans for this combined railway and municipal improvement have been prepared under the direction of John F. Wallace, chairman (now resigned), and Edward J. Noonan, chief engineer of the Chicago Railway Terminal Commission.

New State Administrative Code for Washington

Under a state administrative code passed by the last session of the Legislature seventy boards, bureaus, and commissions in the State of Washington were superseded on April 1 by ten departments, as follows: (1 Public Works; (2) Business Control; (3) Efficiency; (4) Taxation and Examination; (5) Health; (6) Conservation and Development; (7) Labor and Industry; (8) Agriculture; (9) Licenses; (10) Fisheries and Game. The act also provides for nine administrative committees to have charge of constitutional and statutory duties not in conflict with the administrative consolidation program. Among these committees is one on highways and another on state parks. The Governor and the directors of the ten departments constitute an administrative board, of which the Governor is chairman. This board has certain powers in the way of systematizing and co-ordinating the duties of departments, classifying subordinate employees, and other matters more or less common to all departments. Appointees to the positions of department directors of most interest to readers of this journal are: Public Works, E. V. Kuykendall, of Pomeroy; Efficiency, L. D. McArdle, Olympia; Health, Dr. Paul Turner, Seattle; Conservation and Development, Dan A. Scott, Reitzville.

Concrete Wireless Tower 672 Ft. High in Japan

Highest Masonry Structure Is Coniform in Shape and Follows Chimney Construction and Design in Details

A REINFORCED-CONCRETE tower 660 ft. above ground level and 672 ft. above the bottom of footings has been built as a wireless telegraph station at Tokyo for the Imperial Japanese Government. This is the highest masonry structure on record, surpassing by seventy or more feet the record-breaking chimney. A view herewith shows the structure completed to the 360-ft. level and the drawings give the important details of design.

672-FT. CONCRETE WIRELESS TOWER AT THE 360-FT. STAGE

The tower is coniform in shape and follows chimney practice. At ground level it has a shell thickness of 33 in. and a center diameter of 55 ft. There is a straight taper to a shell thickness of 6 in. and a center diameter of 4 ft. Reinforcement consists of vertical rods and hoops. At the base there are 200 1-in. vertical rods with ¾-in. round hoops on a 4½-in. pitch; at the 100-ft. level, where the reinforcement is heaviest, there are 285 1¼-in. verticals and ¾-in. hoops on a 5½-in. pitch; at the top there are 25 1-in. verticals with ¾-in. hoops on a 7-in. pitch.

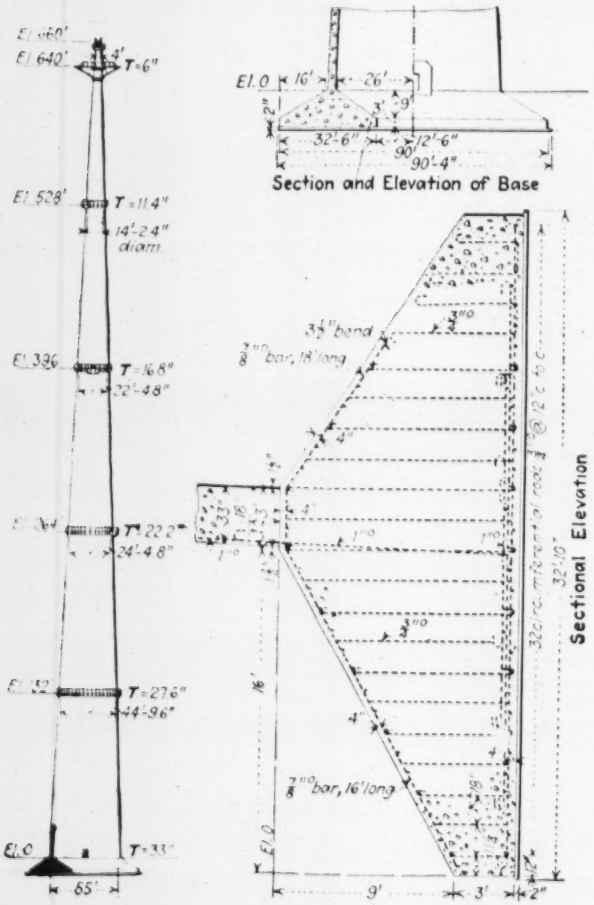
The base consists of an annular ring of triangular cross-section, 12 ft. high and 32 ft. 10 in. wide, leaving a central opening not covered with any footing. This base rests directly on a firm gravel and clay formation; it is heavily reinforced as shown in the accompanying drawing. As the base is about 50 ft. above the water the top of the tower is approximately 720 ft. above sea level.

A wind pressure of 30 lb. per sq.ft. of projected area and temperature stresses due to a range from 20 to 100 deg. F. were factors in the design, which was checked by Professor Shibata of the Imperial University of Tokyo. Further, the tower is designed to withstand earthquakes, which are numerous in Japan. The pressure on the base is about 4,200 lb. per sq.ft., exclusive of wind load. Gravel concrete of 1:2:4 mix is used, made with Japanese portland cement and mixed to a fairly wet consistency. There are approximately 4,420 cu.yd. of concrete in the shaft and 1,640 cu.yd. in the foundation, together with 425 tons of American steel.

All construction work and hoisting of material was done from a central timber tower. Three 5-ft. lifts of wood forms were used, each lift being bound with wire cables. As soon as the top or third form was filled the first form was released and erected on top.

Progress ranged from 88 cu.yd. per day at the bottom to 1.2 cu.yd. per day near the top. All the work was done by native labor.

In the center of the shaft is a steel stairway leading to an open platform at the top and having landings to exterior galleries at intervals. At the top are steel arms for the inclined wire antennæ, which are led to the ground. It is expected that the plant will give direct wireless communication with San Francisco, Cal.



DETAILS OF BASE AND GENERAL DIMENSIONS OF HIGH CONCRETE TOWER IN JAPAN

The tower was designed and erected according to the patented system of the Weber Chimney Co., Chicago, the work being executed under the supervision of the Oriental Compressol Co., Tokyo, Japan.

Railways in Japan

A report of the government Railway Department of Japan with statistics for the year ending March 31, 1919, gives a total of 6,932 miles of line, of which 5,269 miles were single track, the total trackage being 9,503 miles. In addition there were about 1,800 miles of private and light railways, but all the important private lines were purchased in 1907, as noted in *Engineering News-Record*, Aug. 19, 1920, p. 364. In that article, however, the date was erroneously given as 1917. An important work still in progress in 1919 was a relocation near Kozu to replace the Hakone pass summit and grades of 2½ per cent by a line with maximum grades of 1 per cent requiring a 4½ mi. tunnel.

Interesting the Young Men in the Boston Society

DURING his presidency of the Boston Society of Civil Engineers Leonard Metcalf, among his efforts to better the service of the society to its members, gave much consideration to methods of interesting the young men in the work of the organization. Conferences were held with the young men, resulting in the conclusion that discussions of designs and designing methods would likely prove of most interest and value. It was further determined that the management of the new activity should be in the hands of the young men themselves.

Accordingly a nucleus of about forty young members, largely designing engineers in the leading offices of the city, was brought together and after maturing a plan the Designers Section of the Boston Society of Civil Engineers was formerly inaugurated.

Method of Operation

The section being designed to interest only the young men, the method of conducting meetings is fitted to their needs and wishes. The meetings start at 6 o'clock and last about two hours. About an hour is devoted to the initial presentation of a subject and the remaining hour to discussion. The sessions are entirely informal. It has been found that it is difficult to get speakers if the papers must be written in advance and if there is a stenographic record of the proceedings. Consequently manuscripts are not demanded and there is no stenographic report. The meetings are held in the library with blackboard and stereopticon available. The asking of questions is encouraged and it is distinctly understood that any one present may interrupt the speaker in order to have him clarify a point, solve a difficulty, or meet an objection. In order to promote better acquaintanceship it is intended that each man upon rising to speak shall give his name and the office with which he is connected.

Experience has indicated that the best meetings are those in which actual designs, rather than mere theory, are discussed. It is preferred that the speaker select a design that has been developed recently in the office in which he is engaged and upon which he personally has been employed. He gives the conditions which must be met, the stress and other assumptions, the reasons why certain designs were chosen, describes alternative designs that were considered and states the reasons for their rejection, etc. As a rule others present have had experience with constructions of a similar kind and they ply the speaker with questions, tell why they used different assumptions and different details, and, in general, by exchange of experience try to open up the subject in all its aspects.

Foundation design furnished interesting discussions for two meetings. The first evening began with a description of a very difficult foundation the design of which had just been completed in one of the Boston consulting offices. One of the young men who had been engaged on the work presented the subject. This led, naturally, to a subsequent discussion of the design of the foundation of the Boston army base.

The theory of flat slabs and a flat slab which had been designed in a Boston office furnished the subject for another meeting. Other subjects have been: Small concrete highway bridges, borings, concrete ship con-

struction, methods of waterproofing, concrete road construction, practical designs from the contractors' point of view and rigid concrete frames.

While the older members of the organization have refrained from coming to the meetings, the section itself has taken the initiative of inviting one or two older men when it was desired to get maturer judgment or greater breadth of experience on a difficult problem. In some cases the older men thus invited participate in the presentation of the subject; at other times they act as counselors after the young men have explained a design and discussed its theory.

Success of Section

The work of the section is considered by the young men themselves and by the officers of the society to be a great success. At the initial meeting twenty-three were in attendance. The average attendance now is about forty, and the mailing list of those who have attended one meeting or another is fifty. In other words, a very large percentage of the section membership attends the meetings. There are no membership dues and no qualifications for membership other than that one must be a member of the Boston Society of Civil Engineers. Not only has the section drawn together the young men who were already members of the society, but at least twelve young men have joined within the last year on account of the activities of the section. It is believed that the membership of the section could be quite considerably increased if active efforts were made to recruit members, but it was considered better to allow the section to grow gradually as a result of its good work, rather than to drag in many who might prove indifferent and later drop out.

The first year's officers were: Chairman, Ralph W. Horne, of the office of Fay, Spofford & Thorndyke; vice-chairman, Ralph E. Rice, of the staff of Simpson Bros. Corporation; clerk, Arthur L. Shaw, of the staff of Metcalf & Eddy.

The officers for the present year are: Chairman, Ralph E. Rice; vice-chairman, E. S. Parker, of the staff of Burr & McLaughlin, architects; clerk, Arthur L. Shaw.

The three officers with three additional members of the section and the president of the Boston Society *ex officio* form the executive committee of the section.

Pennsylvania System Maintenance Costs

According to estimates of 1920 expenditures, new rails and cross ties used to replace old and worn-out trackage cost the Pennsylvania Railroad approximately $11,990,000. This amount is the approximate net cost of the new material and represents a saving in the salvage of the replaced rails amounting to some $2,400,000. About 95,000 tons of new steel rails and 5,300,000 new cross ties were used last year. Of the 95,000 tons of new rail laid in 1920, 82,500 tons, or 87 per cent, was heavy 130-lb. rail. The use of heavier than 100-lb. rail was commenced by the Pennsylvania Railroad in 1915. Steel rails for 1920 use cost approximately $48 a ton, an increase of $8, or 20 per cent over the previous year's cost and 63 per cent more than the cost of rails ten years ago. Cross ties cost the Pennsylvania Railroad 32 per cent more in 1920 than in 1919 and 153 per cent more than ten years ago. Since 1910 the Pennsylvania Railroad has laid 1,347,289 tons of new rail and 56,230,904 new cross ties.

Passaic Valley Sewage Decision Against New York

U. S. Supreme Court Refuses To Enjoin Discharge of Treated Jersey Sewage Through 150 Deep Outlets Into New York Bay

THE DENIAL by the United States Supreme Court on May 2 of the application for an injunction against the discharge of sewage from the Passaic Valley Sewerage District into Upper New York Bay (the people of the State of New York, complainants *vs.* the State of New Jersey and the Passaic Valley Sewerage Commissioners) was noted briefly in our issue of May 5, p. 785. The decision ends litigation begun over twelve years ago. The court holds as *not proven* the various claims of New York State that the discharge of Passaic Valley sewage into New York Bay would, in the language of the decision, "create a public nuisance by causing offensive odors or unsightly deposits on the surface, or that it would seriously add to the pollution of" the bay. The court lays stress upon the stipulations between the federal government and the Passaic Valley Sewerage District in 1910 as being in effect a guarantee of the protection of the waters of Upper New York Bay from pollution by sewage from the Passaic Valley. The suit is dismissed without prejudice, thus leaving it possible for New York State to renew an application for an injunction if it deems it necessary to protect its interests after the disposal works have been put in use. The decision recognizes sewage disposal by dilution and the percentage of dissolved oxygen in water receiving sewage as an index of pollution.

In passing it may be noted that the decision has been printed as a pamphlet of about 13 pp. and may very likely be obtained on application to the clerk of the United States Supreme Court, Washington, D. C.

The decision points out that the first commission created by the New Jersey Legislature to investigate the Passaic Valley sewage disposal problem took up its duties in 1896, though the subject had been dealt with by legislative committees prior to this. A second investigating commission was created in 1897 and a third in 1898. In 1902 the Passaic Valley Sewerage District was created by the Legislature, but it was not until April, 1908, that the plan for a trunk sewer as an outlet into New York Bay was adopted by the commission. An earlier plan, not mentioned in the decision, provided for the discharge of untreated or virtually untreated sewage into Newark Bay, but opposition from Bayonne led the Legislature to prohibit discharge at this point.

The court states that the act authorizing the construction of the sewer required the commissioners to make further investigations as to whether the discharge of sewage into New York Bay would be likely to cause a nuisance to persons or property within the State of New York and to submit the results of the investigation to the Governor of New Jersey. This was done, the decision says, and upon consideration the Governor concluded that the proposed discharge of sewage would not cause such a nuisance and the Attorney General of New Jersey also gave as his opinion that the State of New York "could not have any valid legal objection to the use of the sewer as proposed." The court also pays tribute to the character and ability of the various commissioners who investigated the Passaic Valley sewage disposal problem and to the sanitary engineers, chemists,

and bacteriologists employed by the sewage commission.

Reference is made to the creation by the Legislature of New York of a commission to investigate the pollution of New York Harbor, with power to co-operate with the authorities of New Jersey in finding a solution of the problem. Although various conferences were held between the New York and New Jersey commissions, yet "for some reason, which does not clearly appear, no mutually satisfactory course of action was arrived at." In October, 1908, the suit for injunction was begun. Subsequently the Federal Government filed a petition of intervention and was granted permission to join in the suit on the ground of protection to navigation, interstate commerce, and of government property and the life of federal employees upon New York Bay. Before the suit came to trial conferences were held between representatives of the Federal Government and the Passaic Valley Sewerage Commission, and on May 16, 1910, a stipulation was signed under which the Federal Government withdrew from the suit and the commissioners agreed to construct works of a character and capacity and to produce results named in the stipulation. The commissioners also agreed to build additional works if that were decided necessary by the Federal Government after the works went into operation.

The sewage-treatment works on Newark Bay called for by the stipulation include coarse screens, grit chambers, self-cleansing mechanical screens with openings of not more than 0.4 in., and sedimentation basins, the latter of specified sizes and holding or detention. (For the stipulation in full see *Engineering News*, May 12, 1910, p. 566; for editorial comment see p. 561 of the same issue.) The stipulation also provides for the discharge of the sewage near Robbins Reef Lighthouse in 40-ft. depth of water from 150 multiple outlets distributed over an area of 3½ acres, arranged to discharge horizontally across tidal currents. The terms of the stipulation were in accord with "advice of army engineers of high rank" acting for the government and "distinguished sanitary engineers" acting for the sewerage commissioners. Operating results, as already stated, were laid down in the stipulation, besides which the right of government inspection was provided with the right to order additional treatment works. After stating these facts the court declares: "It is obvious that if the conditions of this stipulation are realized and maintained, there will be no occasion or ground for such an injunction as was prayed for."

At this point in the decision the court rules that the agreement between the federal government and the Passaic Valley Sewerage Commission is a valid obligation, within the authority of the Attorney General of the United States on the one hand, and the Passaic Valley Sewerage Commission on the other, the New Jersey Legislature having specifically authorized the commission to enter into the agreement.

After the federal government withdrew from the case, the other parties continued it. The taking of testimony was not concluded until June, 1913, and it was not until the October term of the United States Supreme Court in 1918 that the case was argued. Subsequently it was decided that in view of "the rapid advance in sanitary science then in progress, suggested in the record" additional testimony should be taken to show the present state of the art, whether there was any practicable plan or arrangement for sewage disposal which would lessen the polluting effect of the New York City sewage, and also the "present degree of pollution of the waters of New York Harbor and the change in this respect since the taking of testimony." Accordingly, "much additional testimony was taken." The remainder of the decision is given in full, as follows:

With the record in this state we come to consider the evidence introduced, but subject to the rule that the burden upon the State of New York of sustaining the allegations of its bill is much greater than that imposed upon a complainant in an ordinary suit between private parties. Before this Court can be moved to exercise its extraordinary power under the constitution to control the conduct of one State at the suit of another, the threatened invasion of rights must be of serious magnitude and it must be established by clear and convincing evidence. *Missouri vs. Illinois and the Sanitary District of Chicago*, 200 U. S. 496.

The water of New York Bay is such a brackish combination of salt sea and fresh water that it could not, under any circumstances, be used for drinking or other domestic purposes and, therefore, the reasons given in the bill to justify the injunction prayed for are restricted, as we have seen, to the claims that the addition of the Passaic Valley sewage to the already polluted waters of the bay would result in odors offensive and unwholesome to persons bathing in them or passing over them in large vessels or in small boats or living and working upon the adjacent shores, in causing unsightly deposits on the surface of the water and chemical action injurious to the wood and metal of vessels navigating the bay, and in rendering fish and oysters taken from such waters unfit for consumption.

The evidence introduced as to increase of damaging chemical action upon the hulls of vessels by the proposed addition of sewage, and as to danger from air borne diseases to persons using the water in boats and vessels or working or dwelling upon the shore of the bay, is much too meager and indefinite to be seriously considered as ground for an injunction, and when it is considered that for many years all of the sewage from the great population of New York City and its environs and from the large cities on the New Jersey shore (estimated, in 1912, at 900 m.g.d.) has been discharged for many years into the harbor, quite untreated, the evidence does not justify the conclusion that persons bathing in or that fish or oysters subsisting in such waters can sustain much further damage from the addition to them of the sewage of the Passaic valley, after it has been treated in the manner proposed in the stipulation with the government.

There remains to be considered, therefore, only the offensive odors, and unsightly deposits on the surface which it is claimed will be caused by the addition of the putrescible matter to the water and it is to this claim that a large part of the evidence introduced by the complainant is directed. Much evidence was introduced tending to prove that sewage collected from so great an area as that of the Passaic Valley Sewerage District would be stale, if not septic, when it reached the treatment plant at Newark Bay and that it would, therefore, hold in solution much organic matter which would not be removed by the screening and sedimentation processes proposed, with the result that it would cause disagreeable deposits on the surface of the water—"oily and sleek fields"—and offensive odors near the place of discharge and upon the wharves and shores adjacent to the bay.

On the other hand witnesses of seemingly equal candor and learning, and with large practical experience, called by the defendants, testified that they were confidently of the opinion that the treatment of the sewage provided for in the stipulation with the United States would cause such purification of it that the results guaranteed therein would be fully realized.

It is much to be regretted that any forecast as to what the effect would be of the treatment and deeply submerged discharge through multiple outlets proposed for this large volume of sewage must depend almost entirely upon the conflicting opinions of expert witnesses, for experience with such treatment and dispersion under even approximately like conditions seems entirely wanting. It is, however, of

much significance that the authorities of the City of New York, after many years of investigation of the subject of sewage disposal, in their latest plans propose to adopt a treatment of screening and sedimentation and dispersal in deep water very similar to, but not so extensive and thorough as, that provided for in the stipulation between the defendants and the United States.

There is only one point upon which all the experts called for the opposing parties agree, viz.: that in the present state of learning upon the subject the amount of dissolved oxygen in water is the best index or measure of the degree to which it is polluted by organic substances, it seemingly being accepted by them all that upon the oxygen content in water depends its capacity for digesting sewage—that is for converting organic matter into inorganic and harmless substances by direct oxidation and by sustaining bacteria which assist in such conversion.

The witnesses agree that so long as there is sufficient dissolved oxygen in the water the process of digestion of the sewage will go forward without producing offensive odors and that when it sinks below a required percentage of saturation such odors will appear, but, unfortunately, there is a wide divergence of opinion among them as to what the required lower percentage is. The opinions of seemingly well qualified experts vary in giving from 25 to 50 per cent of saturation as the amount of oxygen necessary to prevent the appearance of such offensive odors from decomposition of organic matter.

Measured by this dissolved oxygen standard, the evidence of the complainant is that as early as 1906 the water adjacent to New York City, especially in the Bronx and lower East River, was much polluted by sewage, but that the water in other parts of the bay, especially near Robbins Reef Light, was somewhat, but not greatly, contaminated. This condition, the evidence shows, continued with no very pronounced decrease in the oxygen content of the water until 1911 when the investigations embodied in the first testimony taken were concluded. And the evidence taken under the order of the Court in 1919 shows an irreconcilable conflict in the testimony as to the then condition of the water, especially near Robbins Reef Light, and as to the probable condition of it to be anticipated in the future. In the interval from 1906 to 1919 the estimated growth of the population of New York City and its suburbs draining sewage into adjacent waters was in excess of 100,000 a year—an increase of population in the aggregate much greater than the total population of the Passaic Valley Sewerage District at present and approximately equal to its estimated population in 1940—and it is undisputed that this New York sewage, untreated, was discharged from over 450 sewers directly into the adjacent waters, for the most part at or above the line of low tide, and that only in a few instances was it carried even to the pier heads.

It would seem, therefore, that if the anticipations of the experts for the complainants, as to the results likely to be produced by the effluent from the sewer of defendants, were well founded, that by the year 1919 conditions in the harbor should have become so pronounced and plain that there could not have been such conflict as the record shows in the testimony of trustworthy and competent scientists as to its then existing condition.

Considering all of this evidence, and much more which we cannot detail, we must conclude that the complainants have failed to show by the convincing evidence which the law requires that the sewage which the defendants intend to discharge into Upper New York Bay, even if treated only in the manner specifically described in the stipulation with the United States government, would so corrupt the water of the Bay as to create a public nuisance by causing offensive odors or unsightly deposits on the surface or that it would seriously add to the pollution of it.

The evidence taken in 1919 also discloses that other means than those specifically described in the government stipulation may be resorted to, if needed, for the purpose of improving the character of the effluent from the sewer, viz.: slower and more prolonged sedimentation processes; additional screening; the aeration of the sewage before it reaches the treatment plant and again after treatment and before discharge into the tunnel conveying it to the bay; and finally, if required, chemical treatment.

Having regard to the treatment of the sewage prescribed in what we regard as a valid contract on the part of the defendants with the government of the United States, to the specific agreement therein for protection of the waters of Upper New York Bay from pollution, and to the means which the government will have to secure further purification, if desired, by refusing to permit the discharge of sewage into the Bay to continue, we conclude that the prayer for injunction against the operation of the sewer must be denied.

We cannot withhold the suggestion, inspired by the consideration of this case, that the grave problem of sewage disposal presented by the large and growing populations living on the shores of New York Bay is one more likely to be wisely solved by co-operative study and by conference and mutual concession on the part of representatives of the States so vitally interested in it than by proceedings in any court however constituted.

The Court, recognizing the importance of the ruling which it is making to the great populations interested, as well in the State of New Jersey as in the State of New York, will direct that the decree denying the relief prayed for shall be without prejudice to the instituting of another suit for injunction if the proposed sewer in operation shall prove sufficiently injurious to the waters of the Bay to lead the State of New York to conclude that the protection of the health, welfare or commerce of its people requires another application to this Court.

It results that the bill of complainants will be dismissed but without prejudice to a renewal of the application for injunction if the operation of the sewer of defendants shall result in conditions which the State of New York may be advised requires the interposition of this Court.

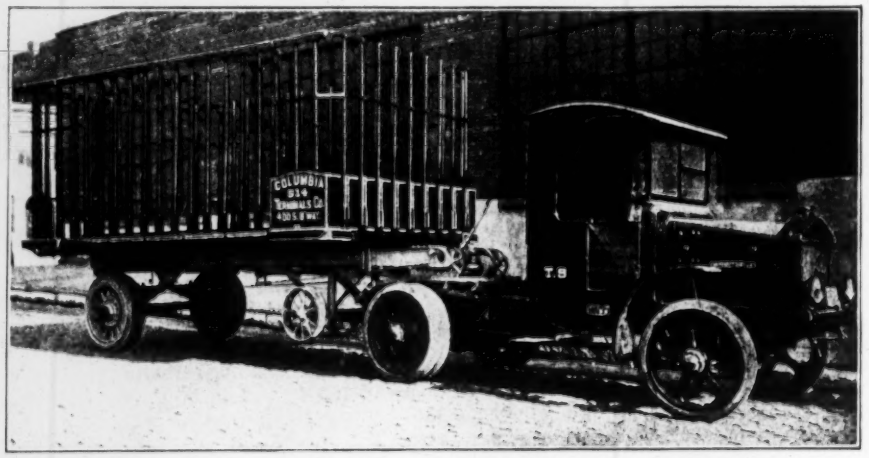
Two Record-Breaking Concrete Arch Bridges

At present the largest span reinforced-concrete arch in the world is under construction across the Mississippi River in Minneapolis, on the line of Franklin Ave. This has a central span of 400 ft. According to an article by M. A. Mesnager in *Le Genie Civil* of Jan. 15, 1921, there will be built soon in France two reinforced-concrete arches which surpass the Minneapolis bridge. One of these, the viaduct across the valley of Bernand in the Loire district, will have an arch of 542 ft. (165 m.) clear span, and a span of 558 ft. (170 m.) center to center of the springing line. This span is a single arch rib 13 ft. wide at the crown and 21 ft. wide at the springing line, and the rise is 96 ft. The rib has a thickness at the crown of 8.2 ft. The whole bridge, which carries a meter-gage railway, consists of the central arch with concrete girder viaduct approaches. It was started in 1913 and the foundations were all placed when the war broke out. On account of the death of the contractor, the work has been suspended for the time being. However, M. Mesnager states that the Minneapolis bridge will be surpassed by a new concrete arch to be constructed across the Seine at Saint-Pierre-du-Vauvroy, near Rouen. This is a reinforced-concrete arch of 410 ft. (125 m.) clear span with a suspended roadway, whose level crosses the arch very near the abutment. This will consist of two parabolic arches of rectangular section to carry a roadway 19 ft. wide with two 5-ft. sidewalks. The same article refers to a project for a bridge at Arstad, Sweden, where there is to be a reinforced-concrete arch, of the general outlines of the Hell Gate bridge, that is, with a roadway halfway up the arch, in which the central span is 558 ft. This bridge, however, has never been started, though there has been a competition for its design.

Tractor-Trailer Freight Transfer at St. Louis, Mo.

Motor Units with Detachable Semi-Trailers Handle L. C. L. Traffic—Railway and Private Stations—No Fixed Plant

TRANSFER of less-than-carload freight by means of a tractor-trailer system is employed at St. Louis, Mo., operating between the freight houses of the numerous railways and between private freight stations operated by the transfer company. The railways running west and east from St. Louis have their wards and freight houses in St. Louis, Mo., and East St. Louis, Ill., on the respective sides of the Mississippi River, About 80 per cent of the less-than-carload freight interchange between them is handled across the river by wagon transfer, in addition to the interchange or transfer between different stations in each of the two cities. Trap cars are used only to a limited extent for the transfer across the river, on account of the great delay in such movements and the switching and per diem expenses incurred by the originating line, the intermediate carrier and the delivery line.



TRACTOR-TRAILER UNIT FOR FREIGHT TRANSFER AT ST. LOUIS, MO.

A considerable proportion of the l.c.l. transfer business in and between the two cities is carried by the Columbia Terminals Co., which handles an average of 3,000 tons daily, of which 1,000 tons consist of through freight transferred from one railway to another. This company acts also a receiving and delivery agent for all the railways, and maintains private or off-track terminal stations in the business district at which it receives freight from shippers, assembles it for shipment and delivers the consolidated loads to the respective railways. Inbound freight is also collected at railway freight stations and transported to the company's local stations, where it is delivered to the trucks or wagons of the consignees. In this way the teaming of individual shippers to and from distant freight houses is reduced materially.

The railways have 13 freight stations in St. Louis and 12 in East St. Louis, Ill. The Columbia Terminals Co. has one off-track station in the latter town and eight in St. Louis, besides a station at a railway siding of the Missouri Pacific Ry. in St. Louis where it specializes in the handling of pool cars. About 1,500 tons of freight are received daily at the company's stations for delivery to the railways.

A tractor-trailer service was inaugurated by the Columbia Terminals Co. nearly two years ago to improve and expedite its transfer business, with results so satisfactory that the equipment is being increased steadily. One of the units is shown in the accompanying view. At present this service is confined to the long trans-river movements, about 80 per cent of the general business being handled by 200 horse-drawn vehicles and 75 motor trucks. For the short hauls the motor trucks have not been found satisfactory, owing to the large proportion of time consumed in standing idle for loading and unloading. The tractor-trailer equipment now comprises 10 tractors and 24 trailers, but 15 additional tractors and 48 trailers have been ordered. Each tractor averages 20 miles daily, with an average trailer load of 6 tons. The maximum distance between two freight stations is about two miles and the speed is limited by law to 10 m.p.h.

One of the principal reasons for the adoption of the tractor-trailer system is that the independent tractors can be kept at work in hauling, which is their proper service, while the trailers are waiting to be loaded and unloaded. Another reason given is that a tractor can pull a load considerably heavier than that which could be placed upon a motor truck. As to the saving in time, on trips for which a horse-drawn vehicle averages an hour a tractor-trailer unit requires only 18 minutes.

From the accompanying view of a tractor-trailer unit it will be seen that the trailers have open bodies with side stakes, the load being covered with waterproof canvas as a protection against damage and loss. Closed bodies which can be locked and sealed have been considered but not adopted, principally on account of the heat of the enclosed body in summer and the reduction in load capacity. Transportation of freight under lock and seal is not considered necessary for protection against loss, as the transfer company's men load and check the freight and give a receipt for it to the delivering line; they also unload the freight and secure a receipt from the receiving line.

Detached trailers at the delivering freight house are loaded by the transfer company's check clerks, who also sign the receipt given to the railway. At the receiving freight house, the tractor remains attached to the trailer and the unloading is done by the driver and his helper, who obtain a receipt for the freight from the railway, the transfer company's responsibility then ceasing. In this respect the system differs from that employed at Cincinnati, as noted below, where closed bodies are loaded and locked by the freight house employees of the delivering line and then unlocked and unloaded by the employees at the freight house of the receiving line, the only duty of the employees of the transfer company being to drive the motor trucks from one freight house to another.

The semi-trailer system is used, in which the forward end of a two-wheeled trailer is carried directly by the rear end of a four-wheeled tractor, the paying load thus serving to increase the adhesion of the driving wheels of the trailer. Trailers of 9 tons load capacity are hauled by 3½-ton tractors. To facilitate the work at the freight stations the trailers are of a type which can be moved around when detached from the trailer. For this purpose, a hinged frame fitted with small wheels is attached to the underside of the forward end of the frame. Before the tractor is detached this frame is lowered to support the free end of the trailer, being secured in its vertical position by a brace.

Automatic operation of the coupler and hinged frame facilitates the work materially. As the trailer is backed against the trailer the coupling is engaged, the auxiliary wheeled frame is raised clear of the ground and locked in position under the body, and at the same time the brake on the main wheels of the trailer is released. Inclined rails on the rear of the tractor engage small wheels on the trailer sills, raising the frame and guiding the coupler into engagement. In detaching the trailer, the driver of the tractor operates a lever which releases the coupler, the same movement causing the auxiliary wheeled frame to drop into its vertical position and the brake to be applied to the rear wheels of the trailer as the tractor moves away.

An advantage claimed over the system of motor trucks carrying demountable sealed bodies, as employed at Cincinnati and described in *Engineering News-Record* of March 11 and Dec. 16, 1920, pages 508 and 1,194, is that the tractor-trailer system requires no mechanical installation at the freight houses and can thus be put in operation without trouble or expense to the railway. In the Cincinnati system, overhead crane equipment is used to transfer demountable bodies between truck chassis and freight house platform, as well as to shift them to position on the platform. The Columbia Terminals Co. states that in the St. Louis system, the time thus required for handling the bodies is saved and the trailer causes no obstruction upon the platform. Detached trailers can be parked at a convenient place and moved to and from the platform by a team as required, but a French railway which uses a similar system for its parcel delivery service at Paris employs a small tractor for thus shifting the trailers at the station.

By the dispatching system of the Columbia Terminals Co. it is possible to know at any minute where a trailer is located and where both the loaded and empty trailers are located. A certain number of trailers are placed at a railway freight station, according to the volume of business. Check clerks are provided by the company to check the freight as it is loaded onto the trailers and to sign for it to the railways. This is called an affirmative loading plan. As far as the railways are concerned their responsibility ceases after the freight is loaded onto the trailers and they obtain a clear receipt from the check clerk, to guard against claims between carriers for error or loss in transfer.

The service rendered by the Columbia Terminals Co. at St. Louis is different from that in other cities, so that comparative costs of operation are not available. For the convenience of shippers and consignees the company has provided extensive terminal facilities in the heart of the business district.

Rates for transfer vary with the character of service. Between one of the Columbia company's stations and a railway freight house the rate is 11 and 13 per 100 lb. if between the two cities, or 7 and 9c. if in St. Louis, the lower rate in each case being for outbound movements. For interchange, or transfer between two railway stations, 9c. if the movement is between the two cities. If the movement is between two stations in one city, the rate is from 4c. for loads up to 10,000 lb. to 6c. per 100 lb. for loads of 15,000 lb. and more. For various specific classes of freight there are special rates ranging from 13 to 37½c. per 100 lb. In most cases a minimum rate of 27c. per load is provided.

Tractor Speeds Delivery on Hauling Job

IN GETTING the Kerckhoff hydro-electric plant ready for service on the San Joaquin River in California a large amount of heavy freight was handled expeditiously by the use of a tractor to which a string of trailers was attached. With the tractor shown in the accompanying illustration and three 5-ton trucks 1,000 tons of freight were moved in seven days from the railroad station at Auberry over the five miles of construction road to the Kerckhoff power plant.

This road had grades up to 12 per cent and curves with a radius of 50 ft. The accompanying illustration shows the tractor train with six 5-ton transformer cases rounding one of the sharp curves. R. C. Starr was construction engineer in charge of the work.

HAULING HEAVY FREIGHT ON THE KERCKHOFF PROJECT

Local Gravel Plant Experiences in Road Building

Analyses of Three Pit Installations Point to Four Main Reasons for Failure in Roadside Gravel Production

By H. T. Tuthill

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ROADSIDE gravel plant equipment and operation call for good engineering judgment if satisfactory economic results are to be secured. In general, lack of complete success and often total failure can be traced to one or more of four causes:

(1) Insufficient preliminary examination of the working site to determine the character and volume of material available and its accessibility.

(2) The mistaken economy on the part of the contractor of utilizing second-hand machinery, which he can buy cheap, but which is not adapted to the work.

(3) The attempt to operate where the percentage of gravel is not fairly high—30 per cent or over. As a live contract requires from 150 to 200 cu.yd. of material each day anything less than 30 per cent gravel is not a paying proposition—too much material has to be handled and the problem of spoiling the waste sand is difficult.

(4) Failure to wash the gravel—not only actually to clean the gravel, but to remove the sand. This is a more or less expensive process, but it is good economy in the end and is the only way to insure the best results.

The preceding conclusions are based on rather extensive observation. In the past six years in eastern Long Island there have been eight projects by various contractors to obtain local coarse aggregate for the construction of concrete roads under contract for the state—six being upland bank gravel plants and two being beach gravel plants. In addition, gravel from the huge windrows piled up on the shore of Fort Pond Bay at Montauk was used by the Federal Government in constructing a concrete highway from the Long Island R.R. terminal at Fort Pond to the seaplane and dirigible hangars about a mile away. These operations have all come under observation and of three of them the knowledge is intimate. Analyses of the three best-known operations follow:

Farmingdale Plant

This plant, in operation 1914 to 1920, is the most successful of those observed. The site of the pit, the machinery used, the high gravel content, and the cleanliness of the material were all factors in this success.

This pit was developed to supply gravel and sand for 9,500 cu.yd. of 1:1½:3 concrete pavement. It is situated on virgin ground, covered with low scrub oak brush. The contour of the land is flat; the water level is 12 ft. from the surface of the ground, and the top soil varies from 0 to 18 in. in depth. Thirty acres of land were purchased for development at $30 an acre. The pit was adjacent to the road under construction and the total average haul for the work did not exceed two miles. Borings made by the contractor to the depth of 80 ft. showed that from 0 to 15 ft. the gravel ran 40 per cent; 15 to 30 ft., 45 per cent; 30 to 50 ft., 60 per cent; and below 50 ft., 80 per cent.

Careful determination of the pit conditions was followed by a careful selection of equipment, which is catalogued briefly as follows:

(1) A 100-hp. boiler furnishing steam for the entire plant.

(2) A 35-hp. double drum Ligerwood hoisting engine, with 18 in. drums, set 125 ft. from the base of the mast.

(3) One Sauerman dragline bucket (1 cu.yd.) and a 97-ft. mast. Bucket operated on a track line cable 600 ft. long, fastened to a bridle at the lower end.

(4) One 8-hp. Worthington-Dean pump 7½ x 7 x 12 in. duplex for wash-water supply, furnishing 250 gal. per minute.

(5) One No. 4 Nye sand pump for boosting sand onto the spoil bank from the sump at the end of the gravity sluice discharge.

(6) One Austin-Western rotary screen, 4 x 16-ft., in four sizes: ½ in., ¾ in., 1½ in. and 2½ in., with a ½-in. sand jacket. Height of screens above foundation, 30 ft.

(7) One 10-hp. Wicks engine for driving the screens—chain drive to flywheel and belt drive from flywheel to screens. Screens charged from overhead hopper and feed delivery controlled from hopper to screens by a small gate set on the base of the hopper.

The capacity of the bins was 800 cu.yd. They had no floors, the material resting on the ground. The available loading capacity was 500 cu.yd. Five men operated the plant including loading. The hauling was done by 7-ton trucks, and the daily output of gravel averaged 150 cu.yd.

Smithtown Plant

This plant, built in 1918 to furnish 4,500 cu.yd. of coarse aggregate, was a contrast in all respects to the Farmingdale plant. The site selected was on the side bank with light timber growth and three to four feet of top soil. It was located almost a mile away from the nearest end of the road contract. The daily output averaged only 35 cu.yd. and the cost of the gravel at a time when labor was comparatively cheap was $1.49 per cublic yard.

It is notable that the plant equipment was meagre, consisting of a small portable Austin bin, with a rotary screen and bucket conveyors, together with a small jaw crusher, an outfit commonly used on up-state work as a crushing plant. The screen was 3 x 10-ft. with 1¼-in. and 2-in. openings surmounted with a sand jacket. There were a 30-hp. Farquhar boiler; one Case 65-hp. tractor with Maney-Baker 1-cu.yd. wheel scrapers for stripping; 500 ft. of 2-ft. Koppel track and 3 cars for spoiling waste sand, and a single-drum steam hoist for hauling cars. This outfit required an operating force of ten men and three teams. No wash water was used and considerable trouble was experienced with damp sand which clogged the ¼-in. sand jacket. Finally, it became necessary to devise a shaker which jarred the screens so as to keep the openings clear.

Noyack Plant

This plant, operated during 1919-1920, is on a beach and the layer of gravel averaged 12 ft., of which 8 ft. was under water. The percentage of gravel was high. The 4-ft. layer above water averaged 50 to 60 per cent and the 8-ft. layer below averaged from 60 to 80 per cent. The gravel ran small in size and there was no waste in tailings. Everything above ¼-in. was utilized, but all the sand was wasted and the output per day for a six-day run averaged only 70 cu.yd. A tabulation of the equipment follows:

(1) A small Acme portable bin and rotary bucket conveyors, capable of 100 cu.yd. output per day.

(2) A 3 x 10-ft. rotary screen with ¼-in. sand jacket.

(3) One Haiss wagon loader, capacity 1 cu.yd. per minute.

(4) Two 1-cu.yd. Koppel cars and 500 ft. of light track, 2-ft. gage, 16-lb. rail.

(5) About 200 ft. of incline trestle for hauling cars up onto dump; grade about 6 per cent.

(6) Four 2-horse scrapers.

(7) One 6-hp. gasoline hoisting engine (single drum) for hauling cars up incline.

(8) One Gould Triplex pump (100 gal. per min.) for supplying wash water, a jet being sprayed into the screens.

An operating force of 14 men was required. About 20 gal. of gasoline and 2 qt. of oil were used per day to run the engines, including pump, hoisting engine, loading machine and the engine furnishing power for the screen and bucket conveyors. Motor trucks of 3-cu. yd. capacity made six round trips per day on an eight- to nine-mile haul. These were engaged at $35 per day.

This method of operation was continued until the beach was stripped to the water level. Then, as it became necessary to contrive some other method to secure the rich deposit of gravel below, a 6-in. centrifugal pump was brought into play as a possible solution. Briefly the equipment assembled was as follows:

(1) One 6-in. centrifugal pump (Morris dredging pump) set in a position to have a 100-ft. suction line, with 12 ft. of suction hose for depth range, and a 15-ft. discharge, with 15 ft. rise; pump, pumping directly into the rotary screen.

(2) One 35-hp. locomotive type boiler with a Blake duplex feed pump for feeding the boiler with water from a driven well on the site.

The Gould Triplex pump was used in connection with this outfit to supply water for a jet to loosen the gravel for the suction intake.

The plant required seven men to operate. It had been in operation only a short time when the rotary screen broke down and gravity screens were installed, the gravel being pumped over them. Baffle boards and grizzlies were set at the upper end of the screens so as to break up the force of the water with a sand and gravel content. This greatly facilitated the clearance of sand from the gravel; waste sand, which was caught in a sump, was sluiced away through a 12-in. pipe. The gravel was delivered to the bins perfectly clean. The centrifugal pump, however, was too small. Nothing less than an 8-in. pump should be used for gravel where the total lift averages from 15 to 25 ft. A 6-in. pump chokes up under the strain. The ouput ran about 8 cu. yd. per hour and the cost of operation was comparatively small.

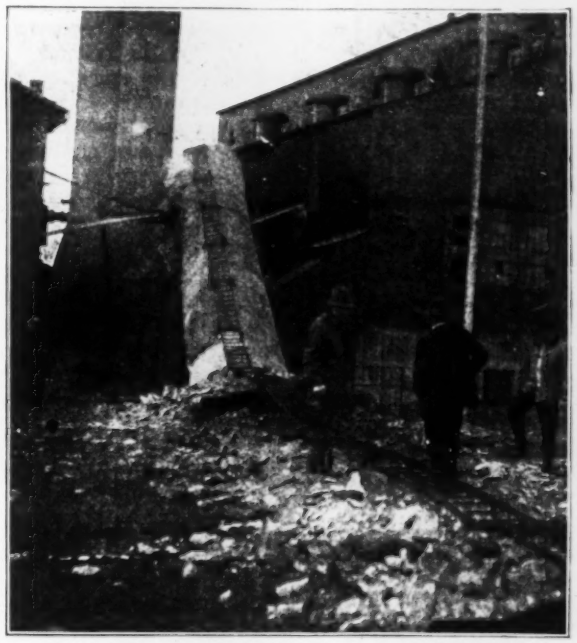
Drilled Plugs Replace Strainers in Terre Haute Filters

TWO pressure filters of the Terre Haute (Ind.) Water-Works Co. were fitted up in 1916 with drilled plugs instead of the conventional strainer screens which had given more or less trouble from "blow-ups" allowing the sand to pass into the city mains. Dow R. Gwinn, president of the company, described the experience in a discussion of a paper by W. W. De Berard on "Perforated Pipe Underdrains" presented recently to the Indiana Sanitary and Water Supply Association.

At the time the change was made the filters were fitted with a new set of extra heavy 1½-in. Buyers pipe laterals spaced on 6-in. centers and tapped 6 in. c. to c. to receive ½ x ¾-in. brass bushings, which were soldered in. Into the bushings were screwed ¾-in. cast-iron plugs. Three sizes of orifice were drilled to give uniform washing and filtering over the bed. Of the 308 plugs in each circular tank 100 have $\frac{3}{32}$-in. orifices, 170 $\frac{7}{64}$-in. orifices and 38 ⅛-in. orifices. A deep file cut across the top of the plug is made to prevent gravel from blanking the orifice. An 18-in. gravel bed supports a 23-in. bed of Portsmouth (Ohio) sand. Mr. Gwinn stated that results after 4 years' operation have been so satisfactory that the other filters eventually will be equipped with orifice plugs.

Felling Four Steel Chimneys Lined Outside with Concrete

DUE to the rapid corrosion in a battery of self-supporting steel stacks of the Walworth Manufacturing Co., at Kewanee, Ill., and later to difficulties arising from unequal expansion when the steel stacks were surrounded by concrete shells, the stacks will have to



STACK CUT 25 FT. ABOVE GROUND FELLED IN PREDETERMINED SPACE

be felled and replaced in rotation. Felling them in the restricted space is difficult. Originally the company had four self-supporting steel stacks rising 165 ft. above the base and 6 ft. in diameter at the top. After 3½ years of service the stacks had corroded to such an extent that it was necessary to take some action. A contract was let to surround the steel stacks with a concrete shell, 6 in. thick for the lower half and 5 in. thick throughout the upper portion. The concrete was heavily reinforced with vertical and horizontal rods from ⅜ to ¾ in. in diameter and with wire mesh.

Sufficient consideration was not given to the difference in expansion between the steel in the old stack and the surrounding coating of concrete. The greater expansion of the steel soon started cracks in the concrete even when the boiler plant was operating at ordinary ratings and with the usual coal. When coal became scarce during the war, oil burners were installed and as the load was unusually heavy, it was necessary to force the boilers. Stack temperatures became so excessive that flames appeared at the top of one of the stacks. The steel work became red hot and weakened to such an extent that the stack began to tilt until it was 4 ft. 8 in. out of the perpendicular. In this bending, part of the concrete shell broke away. One of the engineers happened to notice the dangerous condition of the stack and immediately turned off the fuel on the boilers it was serving. After the shut-down the stack came back toward normal about 1 ft., but it remained 3 ft. 6 in. out of plumb.

This stack was taken down immediately and at the same time a contract was let to fell the other three stacks later on. The first stack had to be taken down in six 25-ft. pieces which were dropped in a space 30 ft. square between the railway tracks and the power house. Each piece weighing about 35 tons was dropped accurately into the allotted space.

The outside stack at the opposite end of the row was the next to be taken down. Space was available to drop this stack in nearly its entire length, the cut being made 25 ft. above the ground to avoid damaging a stairway and pipe tunnels near the base of the stack. After chipping off the concrete, the reinforcing rods were burned off with an acetylene torch and the steel shell was burned through. Including the base the entire stack weighed 300 tons. The dropping was so skillfully done that neither stairway nor pipe tunnels were damaged.

With the two end stacks out of commission, the two middle ones are serving the boilers until two radial brick stacks can be erected in the place of those removed. It will then be necessary to throw the two middle stacks in a restricted place between the new stacks and the buildings, the clearance on either side being not much over 6 in. Felling replacing is being done by Peter Drolshagen, chimney expert, Chicago.

Report on Chicago Garbage Reduction Plant Shows Poor Results

HIGH operating costs and inefficient results of the Chicago municipal garbage reduction plant are due to failure on the part of the city to carry out recommended improvements, to an unnecessary amount of labor with little control of its efficiency, and to lax methods of disposal of the products, according to a recent report made to a council committee by I. S. Osborn, consulting engineer, Cleveland, Ohio.

The quantity of garbage treated has declined steadily under municipal operation, from 152,892 tons in 1915 to 80,132 tons in 1920. The percentage of tankage to weight of garbage (17 to 18 per cent) is higher than in most cities and the grease recovery is only 40 lb. per ton as compared with a usual average of 60 lb. or more; while the quality and price of the grease are lower than in other cities. For the six years 1915-1920 there was a net profit in only one year, but the Cleveland plant, which is nearly comparable, showed a net profit every year. At Chicago, the income per ton of green garbage has averaged $3.46, while at Cleveland it has averaged $5.40, the operating cost per ton ranging from $5.78 to $8.67 at Chicago and from $2.43 to $5.48 at Cleveland for the six years mentioned.

In addition to improvements to the plant and methods of operation, the report recommends reduction in labor and staff, closer supervision of labor, efforts to improve the quality and quantity of product, sale of by-products on the basis of analysis and by competitive bids, and discontinuance of the chemical laboratory. It is suggested also that unless the present cost of operation is reduced the city will benefit by leasing the plant to a company under contract to dispose of the garbage. As to cost of operation in relation to results the report says: "Although the cost is secondary to the social service to be rendered, yet experience demonstrates that a successful solution of the commercial aspects is attainable without sacrificing the quality and character of the benefits due the public."

Swiss Technical Notes

Tests of Large Hydraulic Tunnels One of the Leading Engineering Studies Now Under Way

By Engineering News-Record's Swiss Correspondent

Introductory—In the notes given herewith, and in subsequent installments that he hopes to send, your correspondent desires to place his American colleagues in touch with the state of engineering construction in Switzerland, and the factors which it involves. He hopes that such reports and the publication of more formal technical discussions by Swiss engineers on their outstanding constructions may tend to induce an exchange of experiences from the one side and the other. Our constructions in general will prove not to be notable for their size—the small proportions of our country are to be considered—but possibly these small structures will yet be found to contain many noteworthy features in construction or design, tending to stimulate further development.

Engineering Education and Opportunities

Engineering Education—The current academic year, which began in October, 1920, for the first time in years showed retrogression in the attendance at the highest technical institution of Switzerland, the Eidgenössische Technische Hochschule," or Federal Technical College. The 2,237 students of the year 1919-20 have decreased by 271 to 1,966 at the beginning of the current semester. The different departments of courses are represented in the total attendance register as follows:

Mechanical engineering (including heat and electrical divisions, separate beginning with the fifth semester)	772
Civil engineering	399
Chemical	331
Agricultural	147
Architectural	117
Forestry	70
Pharmacy	56
School for teachers of mathematics	26
School for teachers in natural science	23
Military school*	13
Landscape architects and surveyors	12
Total number of students	1,966

*Intended for the training of instruction officers of line troops. The course includes three consecutive semesters (1½ years). Lectures, seminars and exercises are tuition-free.

The prime reason for the reduction of the number of students is the fact that Swiss money is at a premium as compared with that of the surrounding countries, so that the attendance of foreign students, which in past years has been quite large, is rendered difficult. While during 1919-20 24 per cent of the students came from foreign countries, this ratio has gone down to 17 per cent. The foreign students come largely from European states; of non-European countries only South America sends to Zurich a considerable number (35 in 1919-20) as against only 3 from the United States. Moreover, the rate of exchange also promotes a movement of Swiss students to foreign, particularly German, technical colleges, the effect of which is already perceptible.

Among the significant changes in courses of instruction the lengthening of the civil engineering course from seven to eight full semesters (four years) is noteworthy. Besides the civil-engineering course, the schools for teachers in mathematics and natural sciences

have eight-semester courses, whereas the other departments have only seven semesters. The development of the civil-engineering arts in the last three decades, the endeavor to avoid premature specializing of the students, and the difficulty of developing capable engineers suitable for responsible work in the previous course of seven semesters led to this lengthening of the course. Perhaps the step may be surprising just at present when in all other countries the opposite tendency—shortening of the course—prevails. Which way is the right one is subject of divided opinion even in Switzerland. Your correspondent believes that only a thorough engineering education, which keeps pace with the development of the art and at the same time takes account of the increasing demand for completeness of education, in the several branches can meet the requirements placed on men of leadership today. Those who consider this course too long still have numerous technical schools of middle grade open to them.

Opportunities for Civil Engineers—Just at present the market for civil engineers in Switzerland is very unsatisfactory. While even at the beginning of the past year lively activity in power-plant development seemed fairly certain, this prospect has been eliminated by the temporary postponement of construction work on the large Aare power plant on the Grimsel, at Böttstein-Gippingen and at Rupperswil. Further, since one of the largest employers in the country, the Swiss Federal Rys., has been forced to retrenchment by the tight financial situation, and since, in part voluntarily and in part of necessity, many Swiss engineers have returned home from other European and foreign countries, there is at present a large excess of available men.

Strength of Hydraulic Tunnels

Several high-pressure hydraulic power plants with storage reservoirs are at present under construction in Switzerland, or are merely deferred on account of difficulties in getting money. At the Ritom power plant, recently placed in operation, which will serve mainly for supplying winter current for the electrical operation of the St. Gotthard Ry., the trial operation under pressure (a head of about 35 m. of water) resulted in a break in the tunnel which involved a fairly large loss of water. For a considerable part of its length the tunnel showed cracks in the concrete lining, mainly near the junction of side wall and invert, and in minor degree also at the junction of side wall and arch. The cracks in this oval tunnel-shaped section were exclusively longitudinal cracks. The cause of the break could only be found in the yielding of the surrounding rock strata. To investigate the question of responsibility, and to clear up the physical phenomena in the construction and operation of such pressure tunnels, the owning company, the Swiss Federal Rys., called in a commission of experts. This commission has already completed the first part of its work, dealing with the break of the Ritom tunnel, and has submitted to the authorities a detailed report, which will be dealt with more fully at a later time. The second part of its task, which is awaited with much interest by a large circle of engineers concerned with the construction of pressure tunnels, is at present actively in hand.

To begin with, the yielding of a rock shell under the hydrostatic pressure exerted in operation is to be determined for various rock formations. These tests are to be made in the pressure tunnels of the two power plants of the Federal Railways now under construction—at Amsteg and on the Barberine. They will be made by closing off the tunnel section under study by steel bulkheads and placing it under pressure; especially built instruments with remote indication will measure the give of the rock shell. These tests, it is hoped, will show whether the yielding of the rock is of plastic or elastic character. Preliminary experiments in a test tunnel of the Ritom plant, where pressure was applied to the tunnel walls by hydraulic jacks, showed very considerable plastic deformations in the rock there encountered, a rather weak and fissured material. The tests would further show, in case of elastic deformations, the magnitude and change of the elasticity. Only on the basis of the results will it be possible to determine to what extent they give sufficient data on which to base the design of the tunnel lining.

Besides this principal question of the magnitude and kind of deformation it is apparent that data on other allied questions will result from these studies, such, for example, as the problem of securing a close, solid contact of the lining with the surrounding rock by aid of mortar or cement injection (on which interesting information is given in a report, "Grouting Operations, Catskill Water Supply," in the *Proceedings* of the American Society of Civil Engineers.) The importance of the entire case unquestionably justifies the relatively high costs of the tests.

The commission itself comprises a tunnel expert, an engineer experienced in high-pressure power plants, the professor of applied mechanics and bridges at the Federal Technical College, and two geologists.

Air Blowers Unload Bulk Shipments of Light Commodities

MOTOR-DRIVEN fans have been installed at the Parr terminal in Oakland, on San Francisco Bay, to unload by a so-called air-conveyor or vacuum system, bulk cargoes of copra, sulphur or other commodities not too heavy to be picked up by a current of air. Advantages claimed for this method are that it decreases by about one-third the time which a copra-laden ship must lie at the dock for unloading and that it reduces the cost of unloading as well as the number of men necessary to carry on the work.

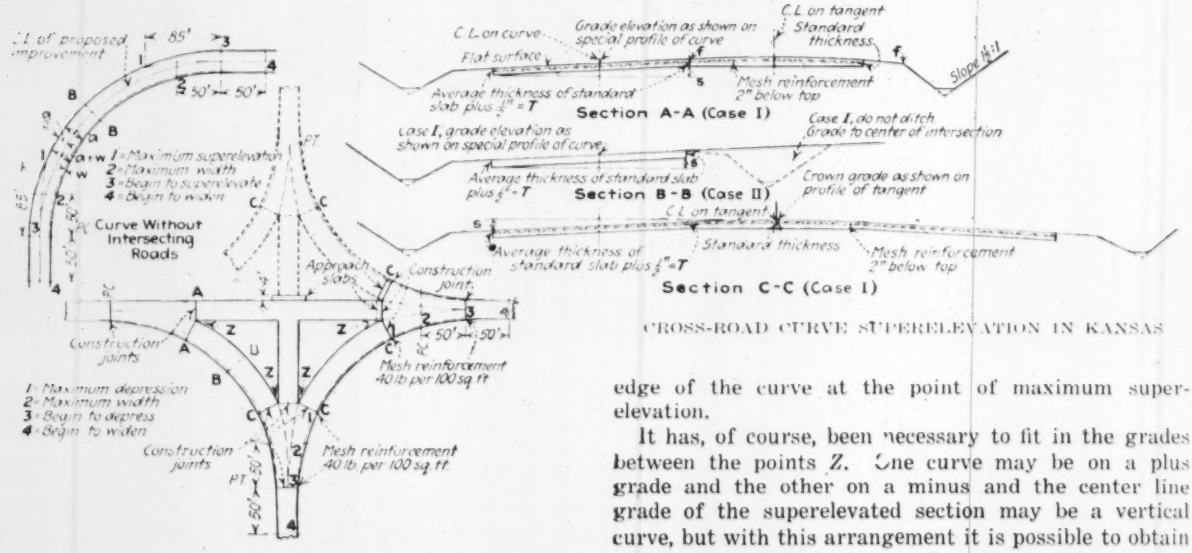
The plant consists mainly of two air blowers operated by 75-hp. electric motors and serving two separate air lines; one creates a suction which draws the copra out of the hold of the vessel, and the other builds up air pressure in a second line which drives the copra through the delivery pipe to railroad cars on the wharf, or bins in the terminal warehouse. The nozzles or intake ends of the line running into the ship's hold are 8 in. in diameter and are made flexible so as to facilitate working in corners and in cleaning up.

In the system as installed at the Parr terminal two such nozzles can be operated simultaneously. The 8-in. lines from these nozzles run to a bridge over the railroad tracks where they unite in a single 12-in. line delivering to a conical shaped separator tank on top of the wharf shed. At the base of this tank a patented gate transfers the copra from the vacuum to the pressure system by which means it is conveyed through the delivery pipe. The average length of pipe-line from the hold of the ship to freight car at this terminal is approximately 135 ft.

Superelevation of Curves at Cross-Roads

By W. V. Buck,
Assistant State Highway Engineer, Topeka, Kan.

THE problem of curve widening and superelevation at cross-roads has been solved by the engineering department of the Kansas Highway Commission in a manner which presents features of interest. In developing the standard solution, particular attention was given to (1) the method of superelevation; (2) the method of and point of beginning widening; (3) the point of beginning of superelevation; (5) the amount of superelevation; (6) the desirable radius and (7) the cross-section of the superelevated section. All these features, as determined, are indicated on the accompanying drawing, for cross-roads and also for single turns.


C.L of proposed improvement
85'
50'
50'
1=Maximum superelevation
2=Maximum width
3=Begin to superelevate
4=Begin to widen
Curve Without Intersecting Roads
Approach slab
Construction joint
Construction joints
Mesh reinforcement 40 lb per 100 sq ft
1=Maximum depression
2=Maximum width
3=Begin to depress
4=Begin to widen
C.L on curve
Grade elevation as shown on special profile of curve
C.L on tangent
Standard thickness
Flat surface
Slope 1/2:1
Average thickness of standard slab plus 1/4" = T
Mesh reinforcement 2" below top
Section A-A (Case I)
Case I, grade elevation as shown on special profile of curve
Case I, do not ditch
Grade to center of intersection
Average thickness of standard slab plus 1/2" = T
Crown grade as shown on profile of tangent
Section B-B (Case II)
C.L on tangent
Standard thickness
Average thickness of standard slab plus 1/4" = T
Mesh reinforcement 2" below top
Section C-C (Case I)

CROSS-ROAD CURVE SUPERELEVATION IN KANSAS

All curves are required to have a radius of at least 200 ft. When the exterior angle is greater than 45 deg. and the radius is 500 ft. or less, the curve is widened according to the accompanying table. Curves of greater radii than 500 ft. are not required to be superelevated or widened; but all curves of 500 ft. radius or less are required to be superelevated ½ in. per foot of width. Other general rules of practice are indicated by the plans or are brought out in the special explanation which follows of cross-roads practice.

As most highway curves in Kansas are at cross-roads particular attention is given to this condition. Having a cross-road it is necessary to carry a grade across the intersection and take off two curves from one place. Therefore it is not possible to secure the superelevation before reaching the P. C., but it must be worked out with the crown line as a dividing point. Also, if the grade is to be properly handled straight across the intersection, it is impossible to superelevate the outside of the curves. Therefore, referring to the cross-road plan, this procedure is followed:

Begin to widen 50 ft. in front of the P. C. and reach the maximum width at 50 ft. beyond the P. C. (widen in 100 lin.ft.). As the first section of the superelevation is one-half the crown of the standard section, start at the P. C., and proceed to depress the inside of the curve and above the crown line out until the maximum depression is reached at a point radially opposite the point where the standard section again shows up, on the tangent leaving the two curves. In doing this a desired superelevation has been obtained and satisfactory grades have been maintained all ways in the crossing roads.

The amount of superelevation used on all curves of 500 ft. or less radius, is ½-in. per foot of width and the minimum width on all curves of 200 ft. or less radius is 20 ft., regardless of the width of roadway up to that width. The cross-section of the superelevated section shows a flat surface between the points of maximum superelevation and is secured by gradually shoving the crown of the roadway over until it reaches the outer edge of the curve at the point of maximum superelevation.

It has, of course, been necessary to fit in the grades between the points *Z*. One curve may be on a plus grade and the other on a minus and the center line grade of the superelevated section may be a vertical curve, but with this arrangement it is possible to obtain satisfactory grades and superelevation without the sacrifice of either. On the curves, where there is no intersecting road, much the same practice is followed, although it is possible on this curve to put in an easement or even obtain the maximum superelevation at the P. C., and the more elaborate design will work out very satisfactorily.

With the minimum radius of 200 ft. on curves there is also required a minimum length of 200 ft. on vertical curves and a 300-ft. unobstructed view of the road from the seat of any vehicle.

STANDARD CURVE WIDTHS ON KANSAS HIGHWAYS

Radius, Ft.	Width on Tangent, Ft.	Width on Curve, Ft.	Width on Tangent, Ft.	Width on Curve, Ft.
200 or over	16 or 18 ft.	20	10	20
150	16 or 18 ft.	22	10	20
100	16 or 18 ft.	24	10	20
75	16 or 18 ft.	26	10	20
50	16 or 18 ft.	30	10	22

In constructing roads of gravel or macadam, where the project turns at a corner, at cross-roads, the cross-roads are constructed to the center of the intersection. If the construction is hard surface it is built only along the line of the improvement and an apron is constructed on the tangent which allows traffic more easily to get on the pavement, and provides for the joining on of future construction in the other direction. A small concrete approach slab is constructed at the end of the apron to protect the edges of the pavement where the traffic comes onto the slab from the dirt roads.

Rehabilitation Requirements of the Denver Water-Works

Additional Conduits from Mountains, New Filter Pumps and a Strengthened Distribution System in Program

IMMEDIATE needs of the Denver water-works require an expenditure of nearly $500,000 according to a report made recently by Burton Lowther, chief engineer and general superintendent. Bonds for $10,000,000 are to be voted on at the municipal spring election, the additional money going for developing sources of supply and reservoir sites. Six major items are included in the recommendations: (1) conduits, (2) more reservoir capacity in the city, (3) an extended and strengthened distribution system, (4) 45-m.g.d. rapid filters at Marston Lake, (5) modernization of pumping stations, (6) acquisition of additional water for future use.

From 1910 to 1918, the Denver Union Water Co., because of uncertainties as to its future status, was not able to make many needed extensions and betterments although it did spend an average of $266,000 annually. Since the city bought the plant, Nov. 1, 1918, it has spent for extensions up to Dec. 31, 1920, $919,000, all taken from earnings. This amount is about equal to the surplus revenues. The bond issue involves no increase in rates but is to be paid for out of the surplus.

Capacity requirements are based on maximum consumption, 86 m.g.d. in 1919 and 96 m.g.d. expected in 1922, as the rate of increase is approximately 5 m.g.d. annually. Under favorable conditions it is estimated that 90 per cent only of the total conduit capacity, equivalent to 77.4 m.g.d., can be counted on safely to bring the water from the mountain foothill sources to the city reservoirs. With storage within the city of 54.5 m.g.d. the stored supply would be exhausted in six days. In 1922 the period of extreme consumption will only need to be prolonged three days to exhaust the stored supply. A new 54-in. reinforced-concrete conduit was started in 1920. About 25,000 ft. were made and 14,000 ft. laid, as described in *Engineering News-Record*, Sept. 16, 1920, p. 551. Completion of this line from Platte Cañon to Wynetka, 23,000 ft. and a new conduit of the same size to Capitol Hill reservoir in the city, 12½ miles, will bring in 50,000,000 gal. a day.

The only unfiltered supply furnished Denver is that from the north end of Marston Lake; the water being passed through 60- and 80-mesh screens to remove some of the vegetable organisms and larger crustacea. The original screen plant built six years ago was described in *Engineering Record*, Sept. 4, 1915, p. 291. A certain number of the organisms pass on to the city reservoirs where they increase in number and cause tastes and odors. A 45-m.g.d. rapid sand filter plant is projected.

Extensive repairs are needed on the outlet of Cheeseman Lake where there is excessive leaking due to the eroding effect of the high velocities. The work will be undertaken under a pressure of at least a partially filled lake and a seamy granite formation must be sealed against the water pressure.

Approximately 1,500 city blocks have inadequate water pressure, chiefly due to lack of large enough mains. Several hundred blocks have no service and urgently need it.

Roofs over the Capitol Hill reservoirs, 6.9 acres in area, are of wood and have so many holes in them that the percolating sunlight causes algæ growths. At each cleaning several truck loads of decayed lumber are found in the bottom. Every snow entails heavy repairs. Removal of an earth embankment between two of these basins and replacement by two concrete walls, making three basins, will increase the capacity by 5 m.g. Asphalt paving on Ashland Ave. reservoir sides and bottom has almost entirely disintegrated, leaving the earth exposed in many places. This makes cleaning difficult. Lack of circulation, together with algæ growths under a portion of the roof where the wood needs replacing, cause objectionable tastes and odors.

The estimates are distributed as follows: $1,670,000 for completion of 54-in. concrete conduits; $1,750,000 for filters and $1,580,000 for distribution system, reservoir repairs, new pumps, and other improvements.

Structural Engineering Research Problems

LARGE-SCALE reesarch in problems of structural engineering was discussed by Prof. W. M. Wilson of the University of Illinois in a paper presented before the Western Society of Engineers May 9. He proposed eight specific problems covering matters in which our knowledge is insufficient for best results in design and construction. They are: (1) The effect of reversed stresses on riveted connections; (2) experimental comparison of the rigidities of different types of wind-bracing connections in high buildings without diagonals; (3) stress distribution among the rivets of large gusset plates; (4) end restraint of bridge stringers; (5) structural value of fitted ends of intermediate stiffeners of plate girders; (6) development of practical rules or formulas for calculating secondary stresses; (7) measurement of secondary stresses in the field; (8) study of the inter-action between floor system and bottom chord in a through truss bridge. Some of these subjects have been studied to a certain extent before this, but nevertheless large uncertainties surround all of them. With respect to tests of the effect of reversed stresses on riveted connections, it is stated that a few such tests have been carried out recently at the Illinois Engineering Experiment Station, with the result of showing that connections designed in accordance with present specifications are likely to develop loose rivets when subjected to stress reversal. Determination of safe unit stresses on such riveted connections and of study of various methods of driving with regard to rivet resistance under stress reversal would be the objects of further tests. In the matter of wind-bracing connections in skeleton buildings, a spliced gusset-plate connection and a connection by knees or end connection angles on the bracing girder have been compared in a limited number of prior tests at Illinois, but these and other types require to be studies by additional tests. With respect to secondary stresses, Prof. Wilson insisted quite strongly on the importance of clearing up the existing doubts as to the need for taking secondary stresses into account in design. The author suggested a co-operative arrangement between a research institution and manufacturers and users of steel, for the purpose of carrying out researches.

Another City-Owned Garbage Reduction Plant

New Bedford, Mass., joined the cities owning and operating garbage reduction plants by taking over the Cobwell reduction works from a private company at a price of $156,400. Some improvements to the plant are being made.

Personnel Board Keeps Close Tab on Contractor's Field Forces

Movements of Chief Employees Scattered Over Active Jobs Extending From Newfoundland to Cuba Graphically Shown

By M. A. Darville
Office Manager, Construction Department, Turner Construction Co., New York City

IN ORDER to keep in close touch at the home office with superintendents, assistant superintendents, timekeepers, material men, etc., and all foremen on active jobs maintained by the Turner Construction Co., New York City, the personnel board, a section of which is shown in an accompanying view, has been developed.

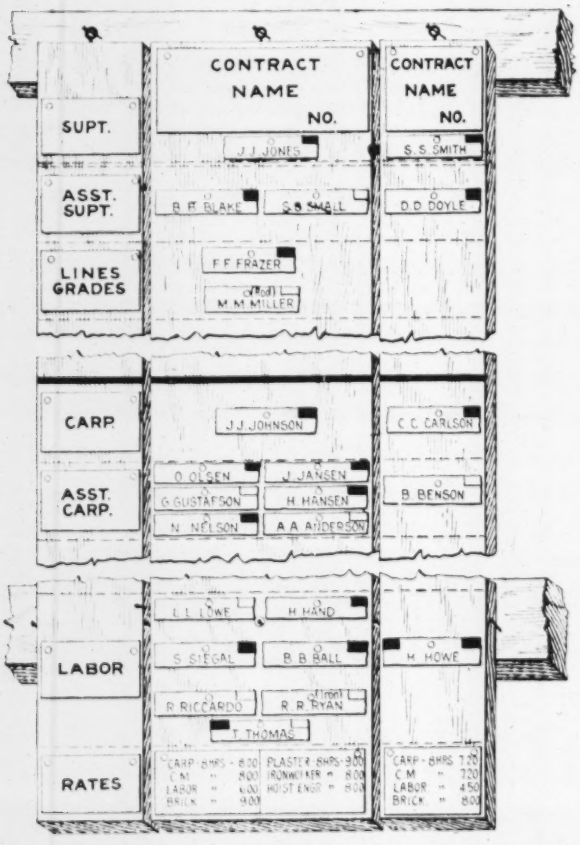


FIG. 1. SECTION OF BOARD SHOWING DETAILED DATA ON LARGE AND SMALL CONTRACT

With this board it is possible to tell immediately what each man is doing and where he is located, whether he is married or single, white or colored, and where his home is located, who is employed on any one of the fifty-one operations scattered from the Island of St. Pierre, near Newfoundland, to Cuba, with a point in Texas as the western limit.

Though this territory is divided up into sections, with headquarters at one of the branch offices of the Turner Construction Co., and with each territory having its own office personnel and in a general way its own construction organization, it is necessary that the home office have complete details as to the movement of all the men in its organization.

"This job must be complete and ready to turn over to the owner in four months," is the demand often made upon us and to get a construction organization on the job at the earliest possible moment is essential. This means that a superintendent, timekeeper, a carpenter foreman and a labor foreman, must be sent to the job right away, an assistant superintendent, material clerk, and other foreman soon to be assigned.

On account of unusual location a new job often presents problems as follows: (1) Total lack of accommodations for families of married men; (2) excessive distance from home; (3) unusual labor conditions—race prejudice; (4) foreign countries; and (5) extreme temperatures.

Many of these obstacles have to be met but once in establishing a factory organization, as the location is permanent, but in construction work all or some of these difficulties are constantly recurring. Where a job is miles from a railroad and there are no accommodations or conveniences of any kind single men are preferred. With a glance at the board, the single men for any trade can be noted.

It is always desirable to keep men near home so, in organizing a new contract, jobs in the territory in question are first studied for available men, and then the other territories are investigated. This information is evident from the color of pins in each man's name slip. Labor conditions may be such that it is not advisable to include colored foremen on this work, and any slips with such marks can be readily dropped out of consideration.

To keep an organization going for years, as this company has done, requires that the construction force be at home, or near home, for some part of the time, as in most cases the novelty of traveling around wears off after a few years. The construction man is always working himself out of a job with small chance of his next one, if any, being in the same place. When a man is married and has family responsibilities, the moving around creates a certain amount of hardship. As the more experienced men are generally in that class a study of the proper distribution among jobs will yield good returns in keeping the older and more experienced men with the company. The following table shows how such a policy has worked out in the Turner Construction Co.:

Position	No.	Average Length of Service	Maximum Length of Service
Timekeepers	47	1 yr. 1 mo.	4 yr. 5 mo.
Material Clerks	22	1 yr. 8 mo.	4 yr. 0 mo.
Engineers	19	1 yr. 9 mo.	3 yr. 3 mo.
Asst. Supts.	33	2 yr. 5 mo.	9 yr. 1 mo.
Supts.	44	7 yr. 0 mo.	18 yr. 1 mo.
Carp. Fore.	49	7 yr. 3 mo.	16 yr. 3 mo.
Con. Fore.	30	9 yr. 7 mo.	18 yr. 0 mo.
Labor Fore.	53	7 yr. 8 mo.	17 yr. 0 mo.

Description of the Board

The board is composed of a number of wooden strips, each either 1¾ in. by 26 in., or 3½ in. by 26 in., suspended vertically from a group of racks on the wall. Each rack holds thirteen small, or six large and one small, board, and a space of ⅛ in. is allowed between the boards. Each board represents a job. Narrow boards are used for small and medium-sized contracts, and wide ones for large operations. Each board is divided into nineteen spaces for different occupations and trades, and all contracts handled by one general superintendent are hung together. Where more than one general superintendent operates out of the same office, the jobs are hung together in order. This arrangement allows for expansion limited only by wall

space, and at the same time permits adjacent jobs to be kept together.

At the top of each board a slip of white bristol board containing the name of the contract in plain heavy single-stroke lettering is fastened with two glass-headed pins, the color of which denotes which general superintendent handles the work. Immediately below, on a much smaller slip, is the superintendent's name. In the next space, the assistant superintendent's name is given and so on through the list including all foremen. No journeymen are listed. Spaces on the job boards are large enough to allow three name slips to be placed one above the other, so that there is room on the narrow boards for three men and on the wide boards for six men in any one space.

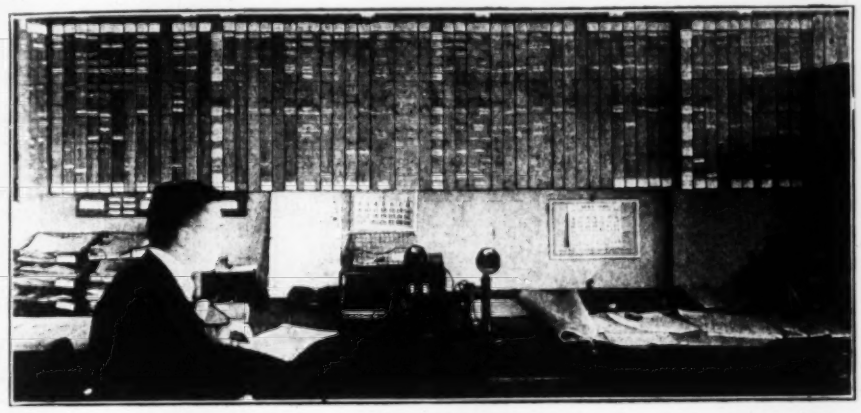


FIG. 2. PERSONNEL BOARD—EACH VERTICAL STRIP REPRESENTS A JOB

Slips for job names are white and those used for the men are on colored paper. In the case of foremen, a color has been selected to suggest as far as possible his trade, as follows:

Trade	*Color*	*Representing*
Carpenter	Light yellow	Fresh lumber
Stripper	Dark yellow	Used lumber
Concrete	Light green	Fresh concrete
Cement Mason	Dark gray	Cement finish
Reinforcement	Dark blue	Steel
Steel laborer	Light blue	Steel
Brick mason	Terra cotta	Brick and tile
Hodcarrier	White	Lime
Laborer	Brown	Sand and dirt
Plasterer	White	Lime
Miscellaneous	White	Trade designated

In the case of stripper foremen, who are carpenters by trade, a small patch of light yellow is pasted on their dark yellow slips, distinguishing them from such foremen as are of the labor type. There is often considerable difference in the scale of wages of these two classes of foremen. In the upper right-hand corner of a man's slip, which is $1\frac{5}{8}$ in. x $\frac{7}{16}$ in., a small block indicates that a man is single; if inked in solid it shows that he is married. Widowers get both symbols.

When there is no mark at all in that corner it is an advertisement of the fact that information is not as yet complete from this man. A black square in the upper left-hand corner indicates that a man is colored. These slips are held in place by glass-headed pins, the color of each pin representing the territory in which his permanent home is located. For example: A man working in the Boston territory, but having a home in the Philadelphia section would have the color of pin corresponding to the Philadelphia territory. Where the location of his home is not known a black pin is used; this is a noticeable reminder that more information is lacking.

The arrangement is such that all men engaged on any particular branch of work are on a horizontal line. For example: By looking across the board all the carpenter foremen in all districts in charge of such work can be easily noted. This is facilitated by inserting a small-sized board between every ten or fifteen jobs containing the names of the different positions and trades in large letters on name plates of the trade color as wide as the board and nearly as high as one space. In picking out men it is of course necessary to be familiar with the stage of operation of each job, whether it is just starting, half complete and how long to go, or practically finished. It is, of course, preferable to transfer men from completed work.

A card index kept in conjunction with the board shows the man's name, permanent and temporary addresses, position, jobs on which he is and has been located, his past and present rates of pay, and any remarks as to ability and special qualifications. As a man is shifted from job to job that fact is noted on the card, and his name is moved on the board accordingly. This means that the information is "up to the minute."

A schedule of rates on each job is kept up to date on the bottom space of each board, and such information is used as a guide for establishing rates for any foremen and journeymen sent to the work. By scanning the job payrolls each week headquarters knows just where each man is, how much he is earning, and also whether the job is working excessive overtime.

In the main office a job record book is kept with an organization sheet for each job, showing what men are there in each capacity, when they started, and when they finished. These three—the board, the card index, and the record book—give the "where is he," and the "who was there," for any man and any job at any time.

The board practically speaks for itself, and those from any other departments desiring the location of any particular person need not bother a half dozen people to get it, but can come and see for themselves. For convenience of such people a large name plate with the city in which the office is located, and the name of the general superintendent, is fastened with the proper colored pins above the jobs handled by this man. For example: Boston has red for a job color, red pins in the men's names whose homes are in Boston territory, and red pins in the label showing job names. A red pin in the Atlanta territory is a danger signal that this man will probably be kicking to get back home.

At one end of the frames a set of boards is labeled for each of the offices. This furnishes a place to put men who are on vacation, sick, or otherwise not assigned. If a man is employed on a straight-time basis his name will appear somewhere on the board.

Engineers Active in Study of Colorado River Problems

Overenthusiastic Newspaper Publicity Leads Many to Believe That Large Dams Will Be Built at Once

ENGINEERING potentialities in the valley of the Colorado River are very great, greater perhaps than for any other river in the country. While there are no navigation possibilities, there must be built sooner or later flood prevention works and structures for the development of power and storage and distribution of irrigation water. Engineers from all of the states watered by the river are busy studying the possibilities and engineering requirements of the future, and have banded together in these investigations in order to co-ordinate their work. It is unfortunate, therefore, that overenthusiastic publicity men have flooded the country with a number of reports which by no means give the present status of the Colorado River investigations and which furthermore have led a great number of engineers all over the country to think that immediately there will be started on the Colorado somewhere a number of dams of record-breaking proportions.

The requirements of flood prevention, irrigation, and power development are so interwoven on the river that it was thought necessary by those interested that the problems be studied together. To this end a so-called League of the Southwest, an organization whose nucleus is the Governors of the States of California, Nevada, Arizona, New Mexico, Utah, Colorado, and Wyoming, was formed some time ago. This league has formed a Colorado River Engineering Commission to gather and put into shape data that can be used as a basis for recommending steps that will lead to the best development of power and irrigation resources on the river. In addition to the engineering commission there is also being formed a treaty commission, consisting of a representative from each state, which will work with the engineering commission to formulate laws relative to the use and division of water in the interstate streams. In the league the United States Reclamation Service is also represented, because that service has built a number of structures along the Colorado River Valley and has studied and is studying a number of others. F. E. Weymouth, of Denver, Col., chief engineer of the Reclamation Service, is serving as secretary of the league.

Report on Imperial Valley

Definite progress in the study of the river was made by the United States Reclamation Service in its investigation made under the Kinkaid Act, which required the director of the Reclamation Service to examine and report on the condition and possible irrigation development of the Imperial Valley in California. The preliminary report pursuant to this resolution was made by Director A. P. Davis in January, 1921, and has been printed as a congressional document. This report states the basic problems of the Imperial Valley under the following heads: Water supply for irrigation, protection from the floods of the Colorado River, available land for irrigation, and canal systems necessary to reach these lands. The report, however, is merely a preliminary one and is to be followed soon by a more elaborate statement of the case.

As a part of this investigation the Reclamation Service has been examining the structural possibilities of the Boulder Canyon site for a dam on the Colorado River. In this connection the report says:

It was demonstrated for several years that for several reasons it is desirable to have a reservoir below the Grand Canyon of the Colorado, which would intercept most of the drainage of the Colorado River and therefore be a more complete solution of the flood control problems. Such reservoir would also be more valuable in the irrigation of the lands on the lower river on account of its greater proximity to them, and the consequent possibility of regulating its flow more nearly in accordance with fluctuating needs. Incidentally it would furnish a large amount of power.

For these reasons a reservoir site has been surveyed in the Boulder Canyon, on the northern boundary of Arizona, below the mouth of the Virgin River. The surveys show a basin of large capacity, provided a high dam is constructed. But investigations so far have not shown favorable foundation conditions. These investigations are still in progress and it has been impossible to complete them in time for the incorporation of an estimate in this report approximating the cost of storage at this point.

Hydro-Electric Possibilities

It may be stated that the Boulder Canyon dam would be from 300 to 500 ft. high and its feasibility depends largely upon the finding of bedrock at a reasonable depth. This is the dam which is so generally reported in the newspapers as about to be built. Obviously there is no basis for any such statement. Power development at this site could be used (1) to pump water for irrigation on the area above gravity flow lines, (2) for municipal purposes in the cities and towns served by the project, and (3) for the use of other municipalities and for sale to private and enterprises.

Some confusion exists in the minds of a number of engineers because of the reports on other dams in the river. There have been applications made to the Federal Power Commission, for instance, for several other dam sites on the Colorado River, notably those made by the Southern California Edison Co. for approximately 4,000,000 hp. power development. These applications are for sites extending from Diamond Creek, at the western boundary of Arizona, to Lee Ferry, just above the Grand Canyon. In fact, the whole district covered is approximately coterminous with the better known part of the Grand Canyon, whereas the Boulder Canyon project is below the celebrated gorge. The Southern California Edison project is purely a power project with transmission possibilities into southern California, and especially to Los Angeles. The company is studying the construction possibilities of the various sites, but no action on the application for licenses has been taken by the Water-Power Commission. In contradistinction to this there have been a number of negotiations between the city of Los Angeles and the federal government regarding the possibility of the city developing for municipal use the power generated at the Boulder Canyon dam, and these negotiations are reported fairly fully in Director Davis' report. The special bond committee of the Los Angeles city council recommended that a special election be held next fall at which time there may be submitted to the voters a bond issue providing $25,000,000 for the development of hydro-electric power in conjunction with other interests at the Boulder Canyon site.

Meanwhile any definite action on Colorado River projects of whatever sort is being held up pending agreement between the various interests concerned, and certainly until the final report pursuant to the Kinkaid act is made.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Little Known Biographies of Engineers

Sir—The favorable attention recently given in your "Engineering Literature" section to books of a biographical character would imply that a presentation of other and little known works of this nature would not be amiss.

It would probably be best to mention first Robert Louis Stevenson's "Record of a Family of Engineers," and "Memoir of Fleeming Jenkins." The memoir portrays the life of a notable English engineer of the last century. Although it does not give the attention to technical detail that engineers would desire, the time expended in reading it is well used. The "Record,' a history of Stevenson's immediate ancestors, contains a portion of his grandfather's diary, written during the building of the Bell Rock Lighthouse, and an excellent analysis and portrayal of an engineer's character and methods.

Another interesting work is the "Autobiography of Sir John Rennie" (London, 1875), which is admirable from the engineering reader's point of view because it gives such detailed, historical knowledge of the many and varied projects in which this distinguished engineer was interested.

Smeaton's biography and collected reports, published in three volumes by the Institution of Civil Engineers, is also characterized by a wealth of detail. In this category may also be mentioned the "Life of Robert Stevenson," by J. C. Jeoffreson (London, 1866), which is rich in historical material.

Another worthy title is the "Life and Labors of Mr. Brassy," by William Helps (Boston, 1874). This concerns the life of the first of the railroad contractors. The life of James B. Eads, by Louis How (New York, 1900), gives in small compass a remarkable amount of information concerning this nationally known engineer. Other books deserving consideration are four collections of short sketches of the lives of prominent pioneers of the profession: "Great Engineers," by J. F. Layson (London, 1880); "Lives and Works of the Civil and Military Engineers of America," by C. B. Stuart (New York, 1871); "Lives of Eminent Mechanics," by Henry Howe (London, 1844), and "Eminent Engineers," by Dwight Goddard (New York, 1906).

"An Appreciation of Two Great Workers in Hydraulics," by Kent (New York, 1912), an account of the lives and contributions to science of Venturi and Herschel, rises above the ordinary, while the "Life of Richard Trevithick," by E. Harper (London, 1912); "The Memoir of H. A. Harvey," by E. A. Harvey (New York, 1900); "Remininscences of a Railroad Engineer," by W. H. Wilson (New York, 1896), may be included here.

Some recent books by engineers, autobiographical in character, are chiefly accounts of travel and contain only general impressions of the country and people visited and little or nothing of professional life and experiences. Outstanding examples are: "Adventures of a Civil Engineer," by C. O. Bruge (London, 1909), and the recently published books by McCarty. These have nothing to distinguish them from the autobiograhies of travelers, statesmen or others without the fold.

Fulton, Ericsson, Watt, De Lesseps and Edison, whose exploits attract the public to a greater degree than those of most engineers, have been the subject of one or more biographies which have not, like most of the other titles, been relegated to the back shelves of the libraries.

Cyclopedia for Railway Men

MAINTENANCE OF WAY CYCLOPEDIA: A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of the Materials, Equipment and Devices Employed in the Maintenance of the Tracks, Bridges, Buildings, Water Stations, Signals and Other Fixed Properties of Railways. Compiled and Edited by E. T. Howson, Western Editor of the Railway Age, and Editor of the Railway Maintenance Engineer, E. R. Lewis, Formerly Chief of the Duluth, South Shore & Atlantic, and K. E. Kellenberger (Signal Section), Editor of the Railway Signal Engineer, Assisted by Homer Hughes, Associate Editor, Formerly Assistant Field Engineer, Interstate Commerce Commission. In Co-operation with the American Railway Engineering Association. New York: Simmons-Boardman Publishing Co. Cloth; 9 x 12 in.; pp. 869; illustrated. Cloth, $10; Leather; $15.

Earlier railroad cylopedias have been confined to the mechanical departments of railroad engineering. This one is notable as the first successful attempt to issue under a single cover such a large mass of information valuable to the railroad maintenance engineer, to roadmasters, and to purchasing departments, despite some elementary and obvious matter and some minor inexactness in definitions. The book has two general sections: the illustrated text, covering 550 pp., and the catalog section, which lists equipment, materials and devices alphabetically by manufacturers' names. The illustrated text is separated into sections devoted to track, bridges, buildings, water service, signals, wood preservation and "general" information, the latter including construction and camp equipment, and a large number of tools and devices.

Parts of the cyclopedia were prepared in collaboration with a committee appointed for the purpose by the American Railway Engineering Association and with several railroad engineers mentioned in the acknowledgments. It includes the last revisions of specifications adopted by the American Railway Engineering Association, the American Railway Association, the Railway Signal Association, the American Wood Preservers' Association, and the Manganese Track Society.

The treatment is generally accurate and comprehensive, with a wise selection of illustrations. Some of the material seems unnecessary. For instance, a sketch is included "showing location of chimney in frame building" with the statement that a chimney is "that portion of a building which contains the smoke flues, especially an upright masonry tube or flue usually extending through the roof and having flue openings for smoke pipes to enter at any convenient height." In the chapter on water service it is not made clear why a dam, defined, in part, "as a bank or mound of earth," should be located "preferably on the railway right of way," nor why "numerous watersheds" make masonry dams necessary in mountainous country. The section on water service is generally comprehensive, but no serious attention is given to the sanitary quality of water.

A general subject index gives references to the illustrated text and the catalog section. There is also an alphabetical index of catalogs, a trade name index, and a directory of products, with alphabetical lists of firms, trade names, and products with manufacturers' names.

The cyclopedia shows an immense amount of painstaking work by the editors and will be of undoubted value to railway maintenance engineers.

The Lay-Out of Small Water Mains

REVIEWED BY ROBERT E. HORTON
of Horton, Barker & Wheeler, Engineers, Albany, N. Y.

THE LAY-OUT OF SMALL WATER MAINS: Notes and Tables Dealing with Various Problems in Simple, Compound, Double and Ring Mains—B. H. H. Hellins, M. Inst. C.E. New York and London: Isaac Pitman & Sons. Cloth; 6 x 9 in.; pp. 45; illustrated. $3.

Devoted exclusively to the solution of problems relating to compound and branching mains and circuits in water-works distribution, this little volume contains more complete and direct methods than are contained in most works on water supply or engineers' handbooks.

The problems are solved by the method of equivalent lengths of uniform pipe, in conjunction with a modified form of the Darcy formula. A table of friction coefficients is given, and the values are considerably greater than those obtained by Darcy, but are intended to apply to somewhat incrusted and tuberculated pipes. The formula itself does not appear until near the end of the text. For the solution of each specific class of problems, a factor or ratio table is given. These factor tables are on double folded sheets at the end of the book, in a form for convenient use and reference in conjunction with the text.

Examples show the application of the methods to various compound and branching mains, and to simple and compound circuits and to a gridiron circuit with a single cross-over. Quantities of flow are expressed in British imperial gallons, but the factor ratios are independent of units of discharge, and the methods of calculation can be readily applied to other units.

Friction heads are expressed in the British form of "inclination," or length of pipe per unit fall. This is the reciprocal of the slope or fall per foot of length as ordinarily used in American pipe flow formulas.

Except as its uility may be limited by the particular formula on which it is based, the book should prove very useful in the design of water main distribution systems, particularly with reference to securing effective gridironing and adequate fire protection.

British Tank Construction

TANK CONSTRUCTION: Relating Principally to the Design, Manufacture and Erection of Tanks in Mild Steel—By Ernest G. Beck, Wh. Ex., Assoc. M. Inst. C.E., Author of "Structural Steelwork," etc. London: Emmott & Co., Ltd. Cloth; 6 x 9 in.; pp. 265; illustrated. 12/6 net.

For a specialist on standpipe or tank work this book would be useful as showing how things are done in England, where the rectangular tank is prevalent. In fact, 134 of the 260 text pages are devoted to a type of structure practically unknown in this country. Circular tanks, according to the author, "vary from about 20 ft. to 200 ft. in diameter and from 15 ft. to 40 ft. in height," which leads one to say, "Other countries, other customs."

The author says he knows of no other book on the subject. Hazlehurst's "Towers and Tanks for Water-Works," *second* edition, a book of 325 pages, was reviewed in the Engineering Literature Supplement of *Engineering News*, April 14, 1904.

How to Use Red Lead for Paint

RED-LEAD AND HOW TO USE IT IN PAINT—By Alvah Horton Sabin, M.S., D.Sc., Author of "Technology of Paint and Varnish," "White-Lead," etc. Member of the American Chemical Society, the Society of Chemical Industry, etc. Third Edition, Rewritten and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 7 in.; pp. 139; illustrated. $2 postpaid.

The first edition of this useful little book was favorably noted in these columns June 21, 1917, p. 602. A second edition, with corrections and additions, appeared in 1919. Both editions were privately printed by the author. The present (third) edition, the author states in his preface, has been "rewritten and amplified to an extent so considerable as to make it almost a new book."

Some idea of the appeal of the present volume to engineers may be gained from the following paragraph from the preface:

The truth is that the last few years have seen a great increase of interest in the subject of [red-lead paint]; due, no doubt, to the rise in the cost of bridges and other metal structures, which makes their preservation more important; this incidentally leads to more discussion of it in the meetings of engineers; . . . This increase of interest [in red-lead paint] is partly due to the comparatively recent introduction of red lead in paste form, which, as is explained in the text, is made possible by improvements in the pigment, and increases its availability for more extensive use. The writer is willing to predict that the next step will be [the sale of red-lead] liquid paint, ready for use; and that this will so much promote its use as a finishing coat and for general repainting that the demand for it will be several times as much as now; perhaps will equal that for white-lead. Holding this belief, which is based on thirty years' experience and study of protective coatings, the writer has tried to give information as to the character of these liquid paints; for all paint must be reduced to this liquid form before it can be applied.

It is pertinent in conclusion to call attention to a review of the same author's "White-Lead: Its Use in Paint," reviewed by A. W. Carpenter, assistant valuation engineer, the New York Central Railroad Co., in these columns for Jan. 20, 1921, p. 126.

American Power Problems During the War

THE POWER SITUATION DURING THE WAR—By Col. Charles Keller, Corps of Engineers; with Appendixes Containing Reports on Conditions in the Several Power Districts. Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 300; illustrated.

Among the many things which two and three years ago we were told would "win the war" power was preeminent. This was not altogether the mere careless use of an advertising slogan; it was largely a fact that to speed up the demanded production a careful utilization of all existing power and an immediate production of as much new power as possible were required. No small part in this power campaign was playel by certain officers of the Corps of Engineers, United States Army, who were detailed to work in the regulation and allocation of electric energy in certain sections of the East. At the head of these officers was Gen. (now Col.) Charles Keller. This is Colonel Keller's report of what was done. Summarizing a prefactory paragraph, the report presents plans for interconnecting existing power systems so as to form a number of so-called power districts and for supplementing their power resources during the next five to seven years by the development of water power upon the greatest profitable scale at certain advantageous localities, the remaining neces-

sary power to be generated in steam stations of the super-power type. To this we may add that as a record of conditions at some of our large power centers, notably at Niagara Falls, the book is invaluable.

The Science of Human Engineering

HUMAN ENGINEERING: A Study of the Management of Human Forces in Industry—By Eugene Wera, M.E., E.E., Industrial Engineer; Assoc. M. A.S.M.E. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 378. $3.50.

We have become somewhat accustomed to the term "social engineering" and now have presented in this book what the author describes as the "first attempt to present human engineering as a science." Quoting again: "The object of human engineering is to attempt to disclose the laws that govern the life of industrial collectivities and to set forth the means by which their activities may be controlled for the expansion of life, which we identify with the promotion of progress."

The volume is divided into four parts: (1) Psychological Evolution of Industry; (2) The Outlook; (3) Elements of Human Engineering; (4) Applied Human Engineering. In the first part the author reviews co-operation, the evolution of industry, the attitudes of labor, capital and management, and also considers competition and monopoly, trade unions, socialism, state socialism, and the co-operative movement. The second part is a general review of the present industrial and labor situation. It contains a chapter entitled "Meaning of Democratic Management," one on "Functions of Co-operative Management," and another on "Committee Organizations." The third section, Elements of Human Engineering, goes into psychology and sociology, but in non-technical language.

The springs of human action entering into production, as concerns the individual and his family, groups, mobs, the public at large, the corporation or other modern production unit and its employees are here considered.

As the author sees it: "No fundamental transformation of industry or society is needed to attain a peaceful settlement of industrial problems. A logical development of our institutions can accomplish it." Again: "The theory of what we call human engineering is not intended for any particular country, though its application is best adapted to America *because this country is the most advanced in democracy.*" (Italics ours.—EDITOR.) In so far as the author proposes machinery, it is the committee system.

Much of the book is not new—and could not be and adequately present the subject. The author's distinctive contribution is in going farther than has been done before in the psychology of human engineering.

Railway Surveying, Track and Roadway

THE PRACTICE OF RAILWAY SURVEYING AND PERMANENT WAY WORK—By S. Wright Perrott, M. A. I., M. Inst. C. E., Professor of Civil Engineering in the University of Liverpool, and F. E. G. Badger, A. M. Inst. C. E., Director of Housing of the City of Liverpool, etc. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 303; illustrated. $10.50.

Although a work in which English practice in railroad surveying, from the reconnaissance to the final layout of roadway and track, predominates, this book contains much of value to American engineers in detailed methods of conducting surveys and in running location including complicated track layout. The book contains little on the economic theory of railroad location, except as introductory to general methods pursued in reconnaissance, preliminary and final location surveys, where detailed descriptions are given of field and office methods, equipment and organization of parties. The mechanics of running railway surveys are dealt with in detail. Some of the methods described will seem meticulous to American engineers who have run locations through rough country, but it should be remembered that the book is designed primarily to meet other conditions. The location of curves, spirals and complicated track work is described at length, as well as the details of setting out construction work. The book contains two long chapters on permanent way, including track and roadway. It carries appendices on barometric measurements, passing of big loads, and track tables.

New York Barge Canal Plans

NEW YORK STATE BARGE CANAL: Book of Plans Issued as a Supplement to the Annual Report of the Department of the State Engineer and Surveyor, Frank M. Williams, 1920—Albany, N. Y.: New York State Barge Canal, Dept. of State Engineer and Surveyor. Cloth; 19 x 13 in.; pp. 156; illustrated.

This appendix to Mr. Williams' 1920 report contains all the necessary structural records of the New York State Barge Canal work. The plates are large, but not too large for convenient filing, and the typographical work is excellent, so that the details of the structure may be read quite as readily as from the original tracings. There are included drawings of the locks, the dams, the movable bridges, the fixed bridges, the power plants, guard gates, aqueducts, culverts, terminal piers and dock walls, lighthouses, post lights, etc. The portfolio represents practically a symposium of modern navigation canal practice.

A Notable Technical Bibliography

THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT: A Bibliography of the Subject with Brief Abstracts, Patents, News Items, etc., Compiled Mainly from Current Literature—By J. Edward Porter, Consulting Chemical Engineer, General Filtration Co., Inc. Second Edition, 1921. Rochester, N. Y. The Author. Paper; 6 x 9 in.; pp. 117. By letter mail, $1.18.

Seldom does one see a technical bibliography so complete, satisfactory, and up to date as this one. It is much more than a reference list. About a hundred pages are filled with condensed abstracts of 606 articles, society papers, news notes, and British and American patents, chronologically arranged. Four indexes follow: (1) Locations of plants with some particulars; (2) names of authors; (3) patents, and (4) periodicals, these two being arranged chronologically and the periodical references giving names of authors. The Bibliography affords a bird's-eye view of the development and status of the activated-sludge process, besides being a guide to as complete a study of the subject as any one may care to make.

Nitrogen and Activated-Sludge

THE CONSERVATION OF NITROGEN WITH SPECIAL REFERENCE TO ACTIVATED SLUDGE—By Gilbert J. Fowler, D.Sc., F.I.C. Bangalore, India: Indian Institute of Science. Paper; 7 x 10 in.; pp. 52; illustrated.

A valuable study of nitrogen conservation, including the importance of the problem, various methods of nitrogen production, particularly activated-sludge possibilities. Mr. Fowler after seeing the early small-scale experiments of the Massachusetts State Board of Health at Lawrence, Mass., started the development of the activated-sludge process on a working scale in England where he was formerly connected with the Manchester sewage-works.

Fresh Treatment of An Old Subject

LANDSCAPE GARDENING—By O. C. Simonds. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 338; illustrated. $6.

Freshness of treatment, sanity, and relative brevity characterize this book. After outlining the aims of

landscape gardening and pleading for the conservation of natural features and resources, the author discusses land, planting materials and planting, water, home grounds, farms, and semi-arid regions, thoroughfares, railway properties, parks, golf and school grounds, arboretums and botanic gardens, cemeteries and city planning. An appendix contains two short papers on landscape work by the late Bryan Lathrop, of Chicago. Brief allusions are made to the part that the engineer may take in landscape planning.

PUBLICATIONS RECEIVED

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings of Annual Convention, 1920—Chicago, Ill.: C. A. Lichty, Secretary, C. & N. W. Ry. Cloth; 6 x 9 in.; pp. 220; illustrated. $1.

Bridge inspection forms, maintenance of timber docks, freight house floors, spray painting, the feeding of extra gangs and methods of filling bridges and trestles are the principal subjects included.

THE BUSINESS LIBRARY: What it is and What it Does—By Louise B. Krause, Librarian, H. M. Byllesby & Co., Chicago. Second Edition Revised. San Francisco, Cal.: Journal of Electricity. Cardboard; 5 x 7 in.; pp. 122; illustrated. $1.50.

The first edition of this useful little book was noticed in these columns March 18, 1920, p. 581. The book now has a half dozen more pages than originally.

CANADIAN RECLAMATION SERVICE: Report, 1919-20—Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 80; illustrated.

Covers irrigation and drainage, with data on duty of water, evaporation, crops, and tables of city water consumption, classified by uses for provinces of Alberta and Saskatchewan.

CONSTRUCTION INDUSTRIES: Proceedings of the Philadelphia and National Conferences Under the Auspices of The Industrial Relations Committee of the Philadelphia Chamber of Commerce and The National Federation of Construction Industries, Philadelphia, Pa.: The National Federation of Construction Industries. Paper; 8 x 10 in.; pp. 254; illustrated.

DESCRIPTIVE GEOMETRY PROBLEMS—By F. G. Higbee, M.E., Professor and Head of the Department of Descriptive Geometry and Drawing, University of Iowa. New York: John Wiley & Son, Inc. London: Chapman & Hall, Ltd. Paper; 12 x 9 in.; pp. 218; illustrated. $1.50.

DETROIT AND WORLD-TRADE: A Survey of the City's Present and Potential Foreign Trade and Seaboard Traffic, and the Facilities Therefore, with Special Reference to the Proposed St. Lawrence Deep Waterway to the Sea—By Thomas Laurence Munger; Compilations by Frank Howard Evans, Statistician. Detroit, Mich.: Board of Commerce. Cloth; 6 x 9 in.; pp. 117; illustrated.

A DICTIONARY OF CHEMICAL TERMS—By James F. Couch, Chemist; Bureau of Animal Industry, U. S. Dept. of Agriculture, Washington, D. C., New York: D. Van Nostrand Co. Leatherette; 5 x 8 in.; pp. 204; illustrated. $2.50.

A handy chemical dictionary, "designed to lie somewhere between that of a standard English dictionary and that of an encyclopaedia; in most cases elementary terms have received more extended treatment than more advanced terms."

DOMINION WATER POWER BRANCH: Report Mar. 1918-19—Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 60; illustrated.

ENGINEERING CONSTRUCTION IN STEEL AND TIMBER: Part I—By William Henry Warren, LL.D., Whitworth Scholar; M. Am. Soc. C. E., Challis Professor of Engineering and Dean of the Faculty of Engineering, University of Sydney. Third Edition. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 486; illustrated. $10.

The first edition was reviewed at length by Prof. Robert Fletcher in the Engineering Literature Supplement to *Engineering News*, June 16, 1910, p. 67. In the present edition "the text has been carefully revised, and additional Appendices have been provided on (a) Australian Timbers, and (b) recent Steel Column Experiments and Formula." The changes and new matter make a net increase of 14 pp. over the second edition. American authorities are cited. This edition is called Part I because it is to be followed by Part II., on Masonry and Concrete Structures.

EVILS OF OVERLOADING—By Robert O. Patten and F. C. Horner. New York: National Automobile Chamber of Commerce, Inc. Paper; 6 x 9 in.; pp. 8.

GYPSUM: Properties, Definitions and Uses—Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 21. 5c. from Superintendent of Documents.

HOW BUSINESS WITH FOREIGN COUNTRIES IS FINANCED, 1921—New York: Guaranty Trust Co. of N. Y. Paper; 6 x 9 in.; pp. 74; illustrated.

HYDROMETRIC SURVEY OF BRITISH COLUMBIA: Report 1918-19—By R. G. Swan, B. A. Sc., District Engineer. Ottawa, Can.: Dept. of the Interior. Paper; 7 x 10 in.; pp. 233; illustrated.

LATITUDE DEVELOPMENTS CONNECTED WITH GEODESY AND CARTOGRAPHY: With Tables Including a Table for Lambert Equal-Area Meridional Projection—By Oscar S. Adams, Geodetic Computer. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 5 x 8 in.; pp. 132. 20c. from Superintendent of Documents.

THE LOCATION, GRADING AND DRAINAGE OF HIGHWAYS: A Concise Discussion of General Principles Illustrated by Current and Recommended Practice—By Wilson G. Harger, C. E., Engineer N. Y. State Dept. of Highways; Former Senior Highway Engineer, U. S. Office of Roads, Author of "Highway Engineers' Handbook," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 294; illustrated. $3.50.

MAINE WATER POWER COMMISSION: Report, 1920. Augusta, Me.: The Commission. Paper; 6 x 9 in.; pp. 271; illustrated.

THE MOTOR VEHICLE—COMPETITOR OR ALLY?—By George M. Graham, Vice-President Pierce-Arrow Motor Car Co. and Member of Motor Truck Committee, National Automobile Chamber of Commerce. New York: National Automobile Chamber of Commerce, Inc. Paper; 6 x 9 in.; pp. 22.

PAMPHLETS AND CLIPPINGS IN A BUSINESS LIBRARY—By Virginia Fairfax, Librarian, Carnation Milk Products Co. Chicago, San Francisco, Cal.: Journal of Electricity and Western Industry. 4 x 6 in.; pp. 62; illustrated. 75c.

Tells how to select, classify and file pamphlets and clippings for a business library.

PERSONNEL RELATIONS IN INDUSTRY—By A. M. Simons, Author of "Social Forces in American History," Formerly Lecturer on Personnel Relations in the Extension Department of the University of Wisconsin, and Manager Personnel Department, Leffingwell-Ream Co. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 341. $3.

PHYSICAL PROPERTIES OF MATERIALS: I. Strengths and Related Properties of Metals and Certain Other Engineering Materials. Edition No. I, Preliminary and Subject to Criticism and Revision. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 52. 10c. from Superintendent of Documents.

Notes and tables published to elicit criticism.

PRODUCTION OF COAL AND COKE IN CANADA, 1919—John McLeish, B. A., Chief of the Division of Mineral Resources and Statistics. Ottawa, Can.: Dept. of Mines. Paper; 7 x 10 in.; pp. 39.

PUBLIC UTILITIES COMMISSION OF CONNECTICUT: Report, 1920, including the Financial Reports of all Public Service Companies (1919), with Statistical Tables Relating Thereto—Hartford, Conn.: The Commission. Cloth; 6 x 9 in.; pp. 784.

PYROMETRIC PRACTICE—By Paul D. Foote, Physicist, C. O. Fairchild, Physicist, T. R. Harrison, Associate Physicist, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 326; illustrated. 60c. from Superintendent of Documents.

RECONSTRUCTION AND PRODUCTION: Report of the Select Committee on Reconstruction and Production, U. S. Senate. Washington, D. C.: The Committee. Paper; 6 x 9 in.; pp. 61.

REDUCING THE TYPHOID TOLL: Five years of Sanitary Progress in West Virginia—Issued by E. S. Tisdale, Director Division of Sanitary Engineering, West Virginia State Department of Health. Charleston, W. Va.: The Dept. Paper; 6 x 9 in.; pp. 36; illustrated.

Reviews typhoid outbreaks in the State by groups of towns having water supplies of different degrees of safety; shows how chlorination and filtration, in conjunction with work of sanitary engineering division of State Department of Health, have reduced typhoid.

REINFORCED CONCRETE DESIGN: Vol. II. Practice—By Oscar Faber, O.B.E., D.Sc., A.M. Inst. C.E., A.C.G.I., etc., Consulting Engineer, Chief Engineer to Trollope and Colls, London, etc. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 246; illustrated. $6.50.

STATE ENGINEER OF COLORADO: Report, 1919-1920 to the Governor—Denver, Colo.: State Engineering Dept. Cloth; 6 x 9 in.; pp. 212.

Consists mainly of stream flow records and allied materials; contains some information on irrigation.

THE STATISTICAL STATUS OF THE SOUTHERN PINE INDUSTRY—By J. E. Rhodes, Secretary-Manager, Southern Pine Association. New Orleans, La.: The Association. Paper; 6 x 9 in.; pp. 16; illustrated.

A STUDY OF MAP PROJECTIONS IN GENERAL—By Oscar S. Adams, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Paper; 5 x 8 in.; pp. 24; illustrated. 5c. from Superintendent of Documents.

THE TESTING OF THERMOMETERS AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—Ottawa, Can. Dept. of the Interior. Paper; 7 x 10 in.; pp. 15; illustrated.

THEORIE des TRAGERS auf ELASTISCHER UNTERLAGE Und Ihre Anwendung auf den Tiefbau nebst einer Tafel der Kreis-und Hyperbelfunktionen—Von Dr.-Ing. Keiichi Hayashi, Professor an der Kaiserlichen Kyushu-Universität, Fukuoka-Hakosaki, Japan. Berlin: Verlage von Julius Springer. Paper; 7 x 10 in.; pp. 301; illustrated. Paper; 40 m.; bound, 50m.

TRIANGULATION IN RHODE ISLAND—By Earl Church, Geodetic Computer, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Linen; 6 x 9 in.; pp. 97; illustrated. 30c. from Superintendent of Documents.

UNDERGROUND CONDITIONS IN OIL FIELDS—By A. W. Ambrose. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 238; illustrated. 65c. from Superintendent of Documents.

VENTILATION IN METAL MINES: Preliminary Report—By Daniel Harrington. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 44. 10c. from Superintendent of Documents.

WATER-GAS APPARATUS AND THE USE OF CENTRAL DISTRICT COAL AS GENERATOR FUEL—By William W. Odell. Illinois Coal Mining Investigations Co-operative Agreement. (This Paper was Prepared under a Co-operative Agreement with the Illinois State Geological Survey and the Engineering Experiment Station of the University of Illinois through its Department of Mining Engineering.) Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 28; illustrated. 5c. from Superintendent of Documents.

WORKMEN'S COMPENSATION LEGISLATION OF THE UNITED STATES AND CANADA—Lindley D. Clark and Martin C. Frincke, Jr., Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 1211.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Practical Concrete Proportioning

Sir—In view of past discussions of the validity of the surface area and water-cement ratio theories of proportioning concrete the article in the March 17, 1921, issue of *Engineering News-Record* by Messrs. Young and McCarthy of the Hydro-Electric Power Commission of Ontario recalls several points which are worthy of further consideration.

These theories as originally proposed were stated to be of general application within the widest practical limits and in the attempt to adapt them to working conditions in the field it will be well to keep in mind the modifications and limitations which have been made and introduced. It should also be recognized that the production of a uniform quality of concrete with the same aggregate is not dependent upon any particular theory of proportioning, but mainly upon a system of field inspection which insures constant quantities of materials from batch to batch.

I previously pointed out, in the April 22, 1920, issue of *Engineering News-Record*, that the results obtained in Mr. Young's application of the two theories could not be considered as a verification of either owing to his elimination of their fundamental features and that his method differed little from what is now common practice.

Referring first to Mr. Young's article in *Engineering News-Record*, Jan. 1, 1920, in his Table III—the following values are found:

Class	Minimum Compound Stress Lb.	Cement, Lb. per 100 Sq. Ft. Normal Consistency
A	2,500	3 18
B	2,000	2 58
C	1,500	2 08

Referring to Table IV in the same article, it will be seen that concretes which he lists to illustrate strengths actually obtained on the work contained a 1:2 ratio of fine aggregate to coarse aggregate. He also stated that "the most economical mixture is the one containing the lowest surface area per cubic foot of material which can be successfully handled and placed."

In my discussion of April 22, 1920, I pointed out, referring to his economical grading that "such a result is, of course, obtained by keeping the fine material in the sand or aggregate to a minimum. Therefore, to obtain low areas it is necessary that the grading of the sand, the material whose variation most greatly influences workability and segregation, be made as coarse as possible and still permit a workable mix." The same result, a low area combination, can also be obtained with a *fixed* sand grading by keeping the relative quantity of sand to gravel as low as possible. I included test results which showed that Potomac River sand might be regraded to furnish an aggregate having 100 per cent greater surface area and yet produce a concrete having the same cement content and flowability with no reduction in compressive strength with the added advantage of greatest practical importance to the field engineer, of no tendency to segregate in the wetter consistencies. In closing I also stated that a 2½:3½ or 2¼:4 sand-gravel ratio will have greater workability for the same flowability, higher strengths, and contain slightly less cement per cubic yard. In other words, concretes may be considerably "oversanded" as compared with the commonly specified 1:2 sand-gravel ratio and result in more economical concretes of equal or better quality. This, of course, absolutely contradicts the surface area theory, since such "oversanded" mixtures may have 50 per cent to 100 per cent more area for the same quantity of cement.

Now refer to the recent article by Messrs. Young and McCarthy in the March 17, 1921, issue. In Table I the following values are found:

Class	Minimum Compound Stress Lb.	Cement, Lb. per 100 Sq. Ft. Normal Consistency
A	2,500	2 60
B	2,000	2 25
C	1,500	1 80

Comparing this Table I with the similar values shown in Table III shown previously, it is seen that for the same consistency he has considerably reduced his cement content per unit area and yet attains concrete of the same quality. The explanation of this is clearly seen in Table II of his latest article. Of the 54 concretes included, only 3 have a sand content which is less than 0.5 of the volume of the gravel or coarse aggregate. All of the remaining concretes, 51 out of 54, are "oversanded" and yet it appears that concretes of the same qualities are produced even though the quantity of cement per unit area has been reduced.

It appears that "oversanded" concretes are now being employed instead of the customary 1:2 sand-gravel relation and a 2,500-lb. concrete is now obtained with 2.6 lb. of cement per 100 sq.ft. of surface area, whereas previously with a 1:2 relation, 3.18 lb. were required. In a similar manner 2.25 lb. of cement now produce Class B concrete which formerly required a cement quantity of 2.58 lb. per 100 sq.ft. of area.

It should be understood, of course, that the difference between these corresponding figures *does not* represent cement *saved*. The cement contents per cubic yard of concrete are probably about the same, the difference in the preceding figures being due to the fact that the "oversanded" mixtures have a higher total surface area. Now, contrary to the surface area theory concretes of higher sand content are employed and the computed weight of cement per unit surface area of aggregate has been reduced without reduction in compressive strength, as should be expected. No doubt the greater degree of workability for the same flowability and greater freedom from segregation are also very marked although not commented upon in the article.

It is clear from a study of old Table III and new Table I, that "oversanded" concretes have proved their worth in actual practice, and in so doing have themselves offered the best possible proof that area may vary or increase within wide limits without requiring an increase in cement content, thereby contradicting the fundamental assumption of the surface area theory.

Without reproducing any of the test data, I must repeat that laboratory tests offer no evidence to justify any consideration being given to the surface-area theory. This also includes concretes and mortars made from similar aggregate gradings employed by the author of the surface-area theory in his original work on which the theory is said to be based. Repeated tests with Potomac River materials definitely emphasized this point and recent work with aggregates available in the vicinity of Saskatoon, Sask., offer even stronger evidence. Concretes in which the sand-gravel ratio varies from 0.5 to 3.0 have practically the same strength when of equal flowabilities and cement content. The quantity of cement per *unit area* is less than half in the latter than it is in the former.

The field experience of the engineers of the Hydro-Electric Power Commission appear to confirm this relation as indicated by their own test data and standards for proportioning. I have no doubt that the adoption of "oversanded" mixtures is "helping them to produce better and cheaper concretes."

Test data are quite consistent in emphasizing that it is unnecessary to vary cement content for ordinary variations in sand gradation for material from the same source. Practically it is an impossible task to attempt to change cement content for the variable gradations which are certain to result from batch to batch. Fortunately accurate test results, as well as the more variable field results, indicate that surface area is not a controlling factor in the production of concrete of predetermined or uniform quality, and may within wide limits be ignored. Attempt to follow such variation as is certain to occur on the job leads to a great amount of expensive and unnecessary work and causes the engineer to feel that uniformity in product is due to his careful attention to a feature which is actually unimportant and might well be disregarded within wide limits.

I have not discussed the water-cement ratio theory as applied in this work since it is quite apparent that with given materials and with batch quantities fixed, the actual quantity of water needed is entirely dependent upon the minimum workable flowability which can be employed on that particular portion of the work. With batch quantities fixed, the addition of more water will lower strength, which in turn necessitates the addition of more cement and *again* more water, to maintain the specified strength and flowability.

The production of concrete of known and uniform quality is neither so scientific nor so mathematical as might be assumed from a study of the many articles and discussions which have appeared during the past few years. To result in the efficient use in concrete of available aggregates I would briefly outline the following procedure, which has been worked out in detail for aggregates available in the vicinity of Saskatoon:

Step No. 1: To determine the "desirable" sand-gravel ratio.

Prepare concretes having the same cement content per cubic yard and the same flowability in which the sand-gravel ratio is varied from 1:2 to 2:1, comprising five or six combinations. Two different cement contents and two different flowabilities may be employed with each aggregate combination. Choice of the "desirable" combination should depend upon ease of working and freedom from segregation as well as compressive strength.

Step No. 2: For the "desirable" sand-coarse aggregate ratio determine the range in compressive strengths for different cement contents and the widest range of flowabilities which need be used in practice. A diagram is then prepared which will show at a glance the relation between compressive strength, flowability and cement content as well as volumes of aggregate required per bag of cement to result in a concrete of any specified strength.

Step No. 3: Involves the application of the method to work in the field and such modification of the curves of the diagram as would seem justified by the results of field tests of concrete taking into account the various factors which cannot be so accurately controlled and measured as in the laboratory. These factors are quality of cement, unavoidable variations in quantities from batch to batch of cement, aggregates and water, and curing conditions. It is presumed that an efficient method of field inspection will be employed. Such a diagram permits the specifying of any desired quality of concrete and indicates qualities of the particular materials which will result in this strength with any required flowability. The chief duty of the inspector is to insure proper measurement of cement and aggregate quantities and to restrict the flowability to the minimum usable for the portion of the structure being poured. Any necessary increase in flowability required should be immediately followed by a reduction in aggregate quantities as indicated by the strength-proportion-flowability diagram.

In conclusion, I do not wish to be understood as deprecating in any way the efficient and complete system of inspection which Messrs. Young and McCarthy have described. Concrete of definite and uniform quality can only be obtained by constant attention to the details of production, and supervision of all processes. Such organizations are the exception, rather than the rule as they should be, and the adoption of a systematic method of inspection on all concrete work of importance will do much to improve quality by bringing to the attention of those concerned the fact that specified qualities are rarely obtained without inspection, and that too often concretes as produced may not only be low in strength, but are extremely variable. I do feel, however, that the attention given to the natural variations in surface area of aggregates is not warranted either by carefully controlled laboratory tests or the results obtained in the field, and that the effort to attribute such uniform results to this factor and thereby verify one or more theories whose conditions are very incompletely complied with, is very misleading and unjustified.

G. M. WILLIAMS,
Professor of Civil Engineering,
Saskatoon, Sask., March 28. University of Saskatoon.

[The foregoing letter was referred to Mr. Young and he has replied as follows—EDITOR.]

Sir—The elaborate discussion presented by Prof. Williams is based on a misinterpretation of the data presented by Mr. McCarthy and myself. The facts are not as he has assumed. His arguments are based on false premises and consequently his deductions are at fault.

For one thing, we are not using oversanded mixtures. While the proportions stated in Table III are different from those given in my article of a year ago, the difference does not represent a change in the quantity of fine aggregate in the mixtures but is due to the different character of the aggregates used in the two cases. The proportions given in Table II are in terms of cement, pit-run sand and screened crushed rock, the former containing varying amounts of gravel and the latter varying amounts of fine material. The sand being fine, had a weight per cubic foot below the average and thus required the use of larger volumes to obtain given quantities of solid material. These facts, and not oversanding of mixtures, account for the differences in the proportions in the two cases.

We have had experience with oversanded mixtures and use them occasionally to meet certain conditions but for the usual run of work we are regularly using mixtures in which the ratio of sand to stone is closely 1: 2. On the same job from which the data of my previous article was obtained, 40,000 cu.yd. of concrete having this ratio have been placed in the last five months and the results obtained have been very satisfactory.

Prof. Williams further argues that this alleged oversanding has allowed us to reduce our cement content per unit area, as witness the difference in the table of cement requirements reported by us now and a year ago. It happens, however, that the tables in question refer to aggregates of different characteristics and to tests made with cement from different mills. The results consequently cannot properly be compared. It so happens that we are still using the former table on the work to which it originally applied.

Prof. Williams' method of determining proportions is cumbersome and expensive. He would require us to make at least 100 test cylinders and suggests more, while the methods we follow require but 30. A conservative estimate of the cost of a concrete test is $6 per cylinder, at which rate Prof. Williams would ask us to spend $600 to $1,000 when the necessary information could be had for less than $200. Unquestionably his method obtains more information than ours but all data essential for setting proportions for concretes of any desired strength and workability can be had from the cheaper tests.

We hold no brief for either the surface area or water-cement theories. There are data which cannot be explained by either and which are apparently in direct contradiction thereto but there are also data which support them and which cannot be ignored. We have never claimed them as general in their application, but used as we have used them they form valuable tools by which proportions can be more accurately set than by any scheme of equal simplicity yet developed. We fully expect them to be superseded at some future time when our knowledge of concrete has broadened but until such time arrives and a better tool is found they should not be utterly condemned.

Prof. Williams in this and other articles repeatedly refers to test data which "conclusively proves" his contentions. It seems a great pity that Prof. Williams has not seen fit to publish these data in detail for other investigators have done so and there is an apparent contradiction between their data and his.

There is an old French proverb which translated reads, "When good men disagree they may be both right." We have found it to be true so often that we suspect it applies in this case and that if all existing test information could be collected together and studied the apparent differences could be satisfactorily explained. After the confusion of the last two years, it would indeed be a step in advance if this could be accomplished.

R. B. YOUNG.
Toronto, Ont., May 3.

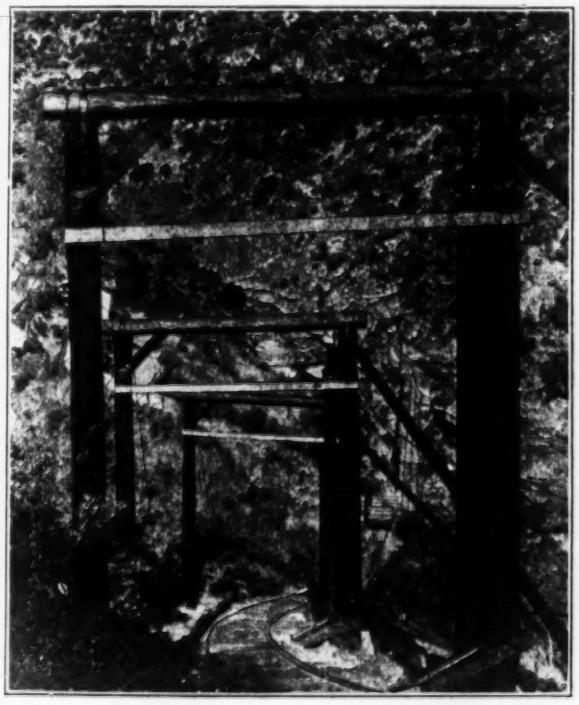
HINTS FOR THE CONTRACTOR

A Good Lagging Tool

A TOOL most useful to men working on repair of timber-lined tunnels has been developed on the Southern Pacific Railroad. It is made by reshaping the points of a well-worn pick into knife or chisel blades about 1½ in. wide which are made parallel to the pick handle. With this tool lagging can be split or chamfered; by reason of the length of the blade it can be used effectively on wood in places where an axe would be less serviceable, and it is particularly useful in shaping firm earth or soft rock for timber in cramped quarters.

Rollers Guide Cable on Steep Freight Incline

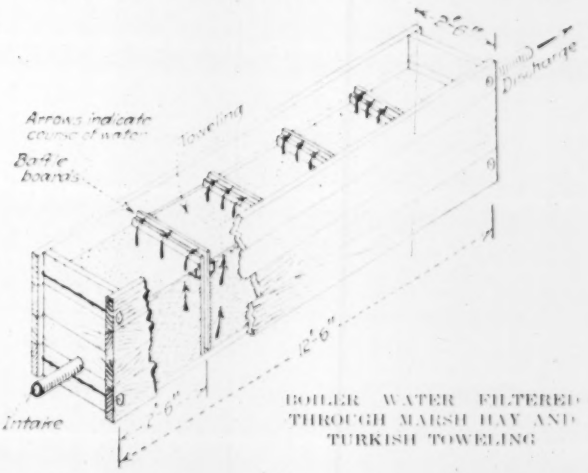
IN DELIVERING supplies and materials to the site of power house number two, built for the Southern California Edison Co., it was necessary to use sharp curves on an incline 7,000 ft. long with grades up to 75 per cent. To guide the cable around these curves a series of well-braced and guyed timber frames were built on the inner sides of the curves, and vertical idlers or rollers were set on each post as shown in the accompanying illustration. The rollers are heavy and at first their weight prevented them from turning readily, so that the loaded cable would often wear into the surface of a roller that did not turn. This was overcome by putting ball bearings on the upper end of the rollers. Small, slightly inclined rollers are used at the base of the vertical posts to serve as idlers to prevent the cable from cutting the timber braces, when it runs at the foot of the vertical idlers. Twenty-ton loads are handled on this incline, using standard-gage cars.



FRAMES AND ROLLERS THAT GUIDE THE CABLE

Hay Filter for Feed Water

WATER, brown with unsettled mud, was made practically clear for feeding boilers on Miami River improvement at Dayton, Ohio, by means of the filter shown by the accompanying drawing. The construction is clearly indicated. Water entering one end near the bottom rises through a layer of marsh hay covered by turkish toweling, then drops down between the double baffle boards into the next compartment where it rises through a second hay and towel filter and so continues through five filters to the outlet. The toweling is tacked to frames which fit into the compartments and the hay is simply packed in evenly. Twice a week the towel screens are removed and new hay put in at intervals when the accumulated dirt clogs the filter. H. A Hanson, superintendent, and V. H. Tucker, fleet captain, of the river improvement operations, introduced the device on the Miami Conservancy District work from the New York Barge Canal operations of C. H. Locher where it had been previously used.



BOILER WATER FILTERED THROUGH MARSH HAY AND TURKISH TOWELING

Cleaning Arch Form with Air Hose Prevents Raveling Concrete

IN LINING railroad tunnels with concrete by the pneumatic method, filling of the side forms ordinarily causes the accidental deposit of more or less aggregate on the center of the arch form where there is little or no slope. This is material which has rebounded from the reinforcing rods or is otherwise separated from the concrete in transit, and for the most part has very little cement attached to it. Even where walls and arch are poured continuously this deposit does not seem to make an effective bond with the last concrete to be placed, and soon falls out after the forms are removed.

This raveling has been effectively prevented on the Southern Pacific R.R. by using a small air hose terminating in a short length of pipe, with which the bottom of the arch form is blown clean just before delivering concrete to the final section in the arch. In this way the deposit is imbedded in the concrete already in place where it can do no harm, and the fresh concrete gives a smooth, firm finish.

NEWS OF THE WEEK

New York, May 19, 1921

Discuss Hudson River Crossing Problem

Engineers Consider Bridge and Tunnel Projects at Am. Soc. C. E. Meeting

Questions involved in the crossing of the Hudson River at New York for better connection of New York City with the western portion of the metropolitan district were discussed from a number of points of view at a meeting of the New York section of the American Society of Civil Engineers on May 11. Prof. W. H. Burr opened the subject, analyzing in general terms the needs of the cross-Hudson traffic and concluding in favor of tunnel construction, in part because tunnels are adaptable to progressive construction as traffic needs and financial possibilities develop. He expressed the opinion that the cost of tunnels for eight railway tracks and fourteen lines of roadway traffic would be less than that of a bridge of the same capacity.

J. A. L. Waddell presented comparative cost curves for eight electric railway tunnels, eight main-line railway tunnels, and four two-line highway tunnels, as well as for bridges having equivalent capacities. The curves indicated that for either railway or rapid-transit service the bridge would be cheaper below a span length of about 2,600 ft., while in the case of highway tunnels the bridge held its advantage up to span lengths well in excess of 3,000 ft.

J. F. O'Rourke submitted a map of a river crossing and freight terminal project devised by himself involving a pair of tunnels across the river connecting the New Jersey Junction Ry. with a New York west side freight subway system to be built from 60th St. down to Murray St. For the tunnels he proposed tubes of 27 ft. internal and 31½ ft. external diameter, to be built preferably of concrete blocks.

Ralph Modjeski, pointing out the difficulties involved in taking care of the enormous vehicle traffic which a bridge as recently proposed would discharge into the congested district of Manhattan, suggested that a highway bridge connecting New York and New Jersey should be located in the Washington Heights district. James Forgie expressed the opinion that tunnels will be found cheaper than bridges if maintenance and real estate costs are considered.

Gustav Lindenthal spoke of the unsolved railway rate question, which will require a new method of New York terminal distribution of freight as soon as the terminal charge is allocated to the traffic. The Hudson River bridge which he has proposed as such a means can be so worked out as to take care of all traffic requirements and avoid difficulties with congestion. J. Vipond Davies, after stating that the topography of the Hudson River banks is such as to give preference to tunnels below 57th St., inquired whether at or north of this point a bridge is warranted. Upon analysis of the existing traffic and discussion of the bearing of progressive construction upon the problem, he declared that a bridge would be an economic fallacy. Clifford M. Holland reviewed the ventilation studies completed and in progress for the Hudson River vehicle tunnel, and outlined the tests now being carried on by the Bureau of Mines with a 200-ft. model of the tunnel equipped with all the essential elements of ventilation according to the design, in which ten automobiles are to be operated as a test of the working of the system.

The meeting was attended by the Italian Commission on American Railway and Industrial Electrification, whose chairman, Guido Semenza, made a brief address on differences between Italian and American engineering problems.

Col. Watson Declines New Jersey Tunnel Appointment

As announced in these columns last week the New Jersey Interstate Bridge and Tunnel Commission on May 10 appointed Colonel George L. Watson one of the three consulting engineers to advise the New Jersey commission on technical matters in connection with the building of the vehicular tunnel under the Hudson River. On May 12 Colonel Watson declined the appointment in the following terms:

"I am at present a member of the consulting board appointed by joint action of the two commissions, which position I could not, of course, consistently hold if I were to try and divide my allegiance between the two states concerned; and having heretofore devoted my entire energy to the project of building the tunnel I cannot see my way clear to becoming the advocate of any one state, believing further that the only position that an engineer can fill in a case of this kind is that his actions should be in the interest of the project as a whole and not divided in any way by state lines.

"While I therefore appreciate the honor of an appointment from the State of New Jersey, I am forced to respectfully decline the appointment tendered."

W. Va. License Bill Passed

The license bill introduced by the American Association of Engineers and the West Virginia Engineering Society at the recent session of the legislature has been passed by the Senate and House, and now awaits the signature of the Governor.

A. A. E. Rejects Plan for Salaried President

Buffalo Convention Revises Constitution—District Offices Discontinued as Economy Measure

Only by rescinding a vote of 7484 to 4591 immediately after it had been recorded was an upheaval in the administrative control of the American Association of Engineers averted on the closing day of that organization's annual convention held at Buffalo, N. Y., May 9-11. With 155 delegates present, representing about 200 chapters and clubs throughout the United States, the main issue of the controversy was the proposal to amend the constitution so as to provide for a paid president. Under the present organization a salaried secretary is the association's executive officer. If the move for a salaried president had succeeded, therefore, it is to be presumed that the executive control of A. A. E. would have passed into his hands, leaving the secretaryship an anomalous position.

It was through the medium of a plea by W. O. Witherspoon, of the Southwestern district, who called for reconsideration of the first vote on the ground that the proposal had not been fully understood and that political log-rolling had been largely instrumental in its passage, that the decision in favor of a paid president was reversed. H. O. Garman the newly elected president, stated that he had entered the campaign with no thought of remuneration other than the honor attaching to the office for which he was a candidate. At a meeting of the board of directors on the last day of the convention C. E. Drayer was continued as the association's secretary.

In its resolutions the association went on record against the passage of license laws which permit the practice of engineering by corporations and unrestricted partnerships. Favorable action was taken on a resolution for the continuance of federal aid in highway construction, but the resolution recommending the creation of a federal highway commission failed to receive the endorsement of the convention.

To a large extent the convention proceedings dealt with the association's internal mechanism, particularly organization, chapter activities and employment service, rather than with problems of broad engineering interest. With the exception of a report on professional practice and fees for consulting work the topics considered related principally to organization. A revision of the constitution consumed a large part of the time.

Approval was given to the plan of dividing the association into 12 districts for the purpose of electing directors; dues were maintained at $15, after a spirited discussion in which a $10 rate had considerable support; an apportionment of funds on the basis of 60 per cent to chapters and 40 per cent to national headquarters was ratified, representing a substantial increase over the previous chapter allotment; the control of collections of association money was given to national headquarters, with a proviso for collections by chapters in certain cases. Salt Lake City was chosen for the 1922 convention.

In a program of curtailing expenses the board of directors elimited the district offices at Washington and New York and suspended the activities of the director of field forces, Dr. F. H. Newell. Treasurer H. W. Clausen's report showed a total of $2.439 cash on hand April 30, 1921, as against $11,421 a year ago. Cash receipts going to national headquarters during the year amounted to $192,179, while disbursements totaled $201,161. The budget for 1921, as originally submitted, amounted to about $160,000 for national headquarters activities, equivalent, on an assumed basis of 21,000 members, to about $8 per member. This sum was reduced to $6 per member and alloted as follows: Business department $3.25; chapter activities $0.25; publishing *Professional Engineer*, $1.10; employment service department $0.40; federal department and field forces, $0.60; directors' expenses, $0.40.

L. K. Sherman, in his presidential address on the achievements of A. A. E. during the year cited the increase of 7,000 in membership in 12 months; the placing of more than 3,000 engineers in positions by the employment service; the activities in securing the passage of license laws by the states; the effort toward establishing minimum fees for consulting work through the medium of the committee on fees and services of practicing engineers; the development of the association's publication the *Professional Engineer;* and the installation of an improved office system at Chicago headquarters as the result of recommendations by a firm of experts in office management. The cost per member for national headquarters service in 1920 was $6.93 (19,000 members used as basis). Mr. Sherman recommended the following activities for the association during the year: Broadening the employment service; active participation in legislative work; educational activities by chapters; development of a national magazine; participtation in business activities of communities by chapters.

Secretary C. E. Drayer, in his address at the opening session, announced the membership as 24,480 on May 1, 1921. There are now 188 chapters and 75 clubs.

The subject of chapter activities was introduced by Dr. F. H. Newell, who outlined in detail a program for stimulating interest in local meetings and making their work effective.

In his report for the qualifications committee R. C. Kellogg advised a steady consistent canvass of new members rather than membership "drives." The time is at hand, he said, when the association must look more to the quality than to the quantity of its membership.

E. B. Miller, employment secretary, reported 20,000 applications for positions received, 7,663 positions vacant, 39,537 men referred to positions and about 3,500 men placed. About 65 per cent of the placements were made by the Chicago office and the remainder by the chapters. The average salary for the positions filled was $190 per month, the lowest $100 and the highest $1,250 monthly. The cost of the service was $6 per placement.

According to Robert Isham Randolph, speaking for the building committee, the time is not ripe for the association to attempt to own a building of its own.

For the committee on services and fees of practising engineers W. L. Benham announced the drafting of a minimum schedule and decried the following practices: Manufacturers furnishing engineering advice; engineers acting both as engineers and contractors at one time; professors or public officials doing consulting work at cut rates; bonding of consulting engineers; acceptance of work on a contingent fee basis; competitive bids for engineering services.

The report of the practice committee brought out a sentiment in favor of speedier action in disciplining a member guilty of unprofessional conduct.

Resolutions

The convention passed resolutions in favor of the following:

An engineer on the Interstate Commerce Commission; a national board for the classification of engineering schools; opposition to laws permitting the practice of engineering by corporations; taking a census of highway traffic; continuance of federal aid for highways; increasing allotment of federal-aid funds in public land states; advancing Government funds for reclamation work; sanitary engineers as public health officers; notice of at least two weeks in case of discharge; plan of financing A. A. E. employment service and consideration of payment for such service; increase of A. A. E. membership from all branches of the profession; fuller statement of the association's ideals and objects.

New Officers

The results of the election of officers was as follows: H. O. Garman, chief engineer, Indiana Public Utilities Commission, Indianapolis, president; A. N. Johnson, dean of engineering, Maryland State College, first vice-president; A. S. Morris, auditor, C. & N. W. R.R., second vice-president; E. F. Ayres, W. L. Benham, Garrison Babcock, Morris Bien, G. M. Butler and W. R. McKeen, directors. H. W. Clausen was reappointed treasurer.

The entertainment features of the convention, in charge of Charles W. Getman, of the Buffalo chapter, included a trip to Niagara Falls, a smoker, and the annual banquet at which Miss Frances Kellor, of the Inter-racial Council, spoke on "Americanization and Man Power Engineering."

Terminal Changes at Portland Are Under Negotiation

Plans to provide a new union passenger terminal at Portland, Ore., which will require radical revision of present freight and passenger terminal layouts and changes in city streets, have recently been under negotiation at Portland, Ore., between the city, the port administration and the railroads affected. Plans so far developed, however, do not contemplate a new union passenger station building since it is thought that a few additional tracks and umbrella sheds will render the present union station adequate. The agitation for this rearrangement began with the recent demand by the mayor that an adequate passenger depot be built for the use of all the roads entering the city. This was shortly after the railroads passed from government control, and the Spokane, Portland and Seattle Ry. and the Great Northern Ry. were preparing to resume use of the old passenger station at Tenth and Hoyt Sts.

Additional Street Traffic

A consequent change in freight terminal layout and operation and location of new freight stations would create additional street traffic on some streets, it is said. Additional width for Hoyt St. and 14th St. is asked by the city. A block in front of the Union Station and a small block west of the post office are asked for use as parks until they are needed by the railroads for terminal development. The city also asks for an additional approach to the Broadway bridge from the west.

The railroads are planning to build a freight yard and roundhouse on land owned in "Guild's Lake," about two miles northwest of the Union Station, by filling in the lake with sand dredged from the Williamette River. The cost of this development, including the fill, will be about $400,000. Until an agreement between the city and the railroads in the matter of vacating street ends is reached, it is said that an estimate of the cost of the whole development cannot be given.

The matter has been under negotiation for some time and more recently has rested in the hands of a subcommittee, consisting of the engineer of the port, the city engineer, and representatives of the Spokane, Portland & Seattle Ry., the Oregon-Washington R.R. & Navigation Co., the Southern Pacific Co., the Great Northern Ry. and the Northern Pacific Ry. It is thought that the city council may ask the people of Portland to vote upon the matter of vacating the streets at the special election, June 7.

Zoning Dominates City Plan Conference Topics

Attention Also Given to Major Street Planning, Population Distribution, Aerial Photography

Zoning dominated the thirteenth National Conference on City Planning, held May 9 to 11 at Pittsburgh. Some two hundred persons from outside places were registered. Meetings were held jointly with the Civic Club and the Real Estate Board of Pittsburgh.

How zoning affects living conditions was the subject of addresses by Robert H. Whitten, Cleveland, and Herbert S. Swan, New York City, in which the theory, practice and benefits of zoning were presented. The proposed zoning ordinance for Pittsburgh was outlined by U. N. Arthur, chief engineer, department of city planning, and J. M Clark, member city planning commission, Pittsburgh. There was a lively discussion of the methods and desirability of limiting special residence districts to single-family detached houses. On the advisability of limiting the number of persons per acre in the various zones there was a marked difference of opinion, but the consensus was against its wisdom.

James D. Hailman, secretary, citizens committee on city plan, Pittsburgh, described the recommendation of his committee for a major street plan which proposes eventually to widen 106 mi. of streets now existing and to add 20 mi. of new street. This compares with the Cleveland and St. Louis programs of widening 190 and 50 mi. respectively, and opening 23 and 17 mi. of new streets. The Pittsburgh proposal is based upon the studies of an active committee of representative citizens, covers 17 main metropolitan district traffic routes, and 64 internal major traffic streets, and the improvements for the relief of congestion in the downtown triangle, as well as the opening up of large suburban areas for residential development.

County Planning Advocated

Statistics of the street and highway situation in Allegheny County, outside of Pittsburgh, were presented by W. McC. Donley, consulting engineer, Allegheny County planning commission, who explained and emphasized the difficulties of proper design, construction, maintenance, and control where these functions are vested in the State, second and third class cities, boroughs, townships, and counties. He recommended that a county highway commission be appointed, consisting of five members, including at least one engineer, one real estate dealer, and one attorney, with authority to plan the county for one hundred years in advance, to be supported by a ¼-mill tax levy and supplied with adequate staff and consultants.

In speaking on "The Enforcement of a Street Plan," A. S. Tuttle, chief engineer, board of estimate and apportionment, New York City, urged the need of flexibility to provide for changes in basic conditions which affect the character of differnt portions of a community, and which may occur imperceptibly. Fixing the width of a street for a definite period of years is a method of much promise. The street should be located to avoid or minimize damages to buildings. The remaining area required for future traffic conditions can be designated as front court yards, and acquired as a right in fee by the city, but subject to the conditions that the areas not to be immediately occupied by the street may be retained by the present owners in their use. Mr. Tuttle concludes that for New York's conditions actual and prompt acquisition of street and courtyard areas is the only safe method of enforcing the plan and this procedure should be observed at the earliest possible date. The discussion on this subject brought out descriptions of methods possible in various states for securing street widening and the desirability of securing the co-operation of the interested property owners, and obtaining donations of land, and even of inducing them to assume portions of the cost of the improvement for which they are not liable under the existing state laws.

Distributing Population

J. R. Bibbins, manager of the transportation department, U. S. Chamber of Commerce, speaking on methods of distributing population, held that the decentralization of population imperatively requires the fullest use of all possible agencies of distribution, including railroads, subways, surface lines, buses, aëroplanes, etc. This local transportation is a natural monopoly and the attainment of the most effective results requires co-ordination of the above named facilities and rigid control of development, all based upon a wise planning for future growth and with the realization that political and geographical boundaries do not have as much influence as the length of ride, whose maximum Mr. Bibbins placed at 30 minutes. He has discovered a definite relation between the growth in population and valuation of property in the larger cities. The district assessment and road tax, and the use of bus lines for the early sparse development, are suggested as partial means of easing the financial burdens of transportation.

H. M. Brinckerhoff detailed some studies of the distribution of the homes of employees of the larger industries and gave the average distances traveled by vehicle and walking by these employees in going to and from work. Two papers on river transportation, dwelling particularly upon the question of terminal and river front improvement, were presented by Maj. J. Franklin Bell, U. S. District Engineer, and Kenneth C. Grant; these contrasted European practice on rivers similar to the Ohio with the local conditions.

John Ihlder, manager, civic development department, U. S. Chamber of Commerce, pointed out the importance of giving consideration to aërial transportation, and the necessity of disregarding political boundaries and of considering metropolitan areas and districts subject to regional planning.

Aerial Photography

A committee report on the use of aërial photography in city planning was presented by E. P. Goodrich, New York City, which pointed out some of the limitations of the process, when applied to city planning work, but concluded that it had great advantages for reconnoissance work. The discussion showed a very active interest in the subject, several novel uses being described.

The use of moving pictures in city planning was the subject of a committee report presented by Herbert S. Swan which described some of the experience of the Chicago Plan Commission and concluded that this device would be useful in showing progress on public improvement construction, congestion of traffic, and, by aeroplane pictures, the results of city planning in various cities.

The conference was closed by John Nolen, who gave as his opinion that among the wrong methods of getting results in city planning were promotion by only one class in a community, excessive promotion and inadequate promotion. He recommended an official planning commission with adequate powers and responsibilities; provision for sound legal advice; a broad but solid financial policy; constant education in schools and in public assemblies; appropriate and timely publicity; a persistent follow-up organization; a competent staff and consultant.

The conference elected Lawson Purdy, of New York, president, and George B. Ford, vice-president, and re-elected Flavel Shurtleff, Boston, secretary.

Conference of State Sanitary Engineers at Boston

Engineers engaged in state and federal health work will hold a conference at Boston, Mass., June 1 and 2. Besides an address on "State Sanitation," by G. C. Whipple, professor of sanitary engineering, Harvard University, there will be papers by R. B. Morse, chief engineer Maryland State Board of Health, W. H. Dittoe, chief engineer Ohio State Board of Health, and a number of other papers; also committee reports on stream pollution and sewage disposal, cross connections and by-passes on water supplies, mosquito control, and rat-proofing; and a discussion of "The Certification and Supervision of Water Supplies on Interstate Carriers," by engineers with the Public Health Service and state departments of health. I. W. Mendelsohn, assistant sanitary engineer U. S. Public Health Service, Washington, D. C., is corresponding secretary of the Conference of State Sanitary Engineers.

To Make "Business" Valuation of New York Transit Lines

A method of valuation based upon "estimated prospective earning capacity" has been included in the new rapid-transit law of the State of New York, following the special message from Governor Miller urging an amendment to provide a method of valuation embodying a standard "employed daily in the conduct of business affairs." The law states that the "value" found shall in no case exceed cost of reproduction less depreciation. It is said that the method prescribed means "value" will be fixed as the capitalized earning capacity that an individual company would previously have been expected to earn now under normal conditions at the original contract rates of fare. With new rates determined by such a valuation, each of the companies would earn the "estimated prospective" amount only provided that present traffic volumes would be the same as those that could reasonably have been expected previous to the war. The Governor's statement also indicates that it would be the intention to consider the future earning capacity of new lines now serving territory expected to develop. The law also provides for equalizing competitive rates between the same points, regardless of the valuation, by prescribing only the method for fixing maximum fares.

Utah Governor Appoints Water Storage Commission

In compliance with the law enacted by the Fourteenth Legislature, providing for a state water storage commission, Governor Charles R. Mabey has appointed the following as members of the commission: W. R. Wallace, E. M. Ashton, R. R. Lyman, W. L. Hansen, W. W. Armstrong, all of Salt Lake County; J. R. Murdock, of Wasatch County; W. V. Creer, of Utah County; A. F. Doremus, of Tooele County, and Sam G. Dye of Weber County. The state engineer is ex-officio a member of the association.

The law creating the commission provides that the body shall conduct investigations relative to water supply for irrigation purposes, and that any county, city or other agency may cooperate with the commission in obtaining data on water supply in that county or city, and that they may contribute to the cost of the work.

Full and proper development and utilization of the state's water supply is the object of the creation of the commission, and it will take over, to a certain extent, the work done during the last two years by the Utah Water Storage Association. An appropriation of $2,500 was made by the Legislature for the purpose of conducting investigations in relation to water supply. None of the appropriation is to be used in salaries, the members of the water storage commission serving without pay.

Hoover Selects Executive from McGraw-Hill Co. as Assistant

F. M. Feiker, vice-president and chairman of the editorial board of the McGraw-Hill Co., has been granted a leave of absence to accept appointment as assistant to the Secretary of Commerce. Mr. Hoover has divided the bureaus of the Department of Commerce into two parts. Assistant Secretary Huston will supervise the bureaus relating to navigation and fisheries while Mr. Hoover will give his personal attention to the bureaus of foreign and domestic commerce, standards and census. Mr. Feiker will directly assist Mr. Hoover in the expansion of these bureaus as aids to business.

The immediate problem is to find out

F. M. FEIKER

what kind of facts and figures industry needs from the government by means of a series of conferences with the representative men of industry. Having organized the department to function according to requirements, the next problem is to devise an adequate system of clearing the collected data back to business. Mr. Feiker's background of engineering training, viewpoint on the needs of industry and sense of publicity should be of unusual service in the furtherance of Mr. Hoover's plans.

Mr. Feiker was graduated in electrical engineering from Worcester (Mass.) Polytechnic Institute in 1904. Following graduation he assisted in special research work in high-tension transmission and generation at Worcester. From 1906 to 1907 he served the General Electric Co. at Schenectady, N. Y., as technical journalist, and in the latter year went with the magazine *System* at Chicago, shortly after developing the idea of *Factory*, of which he became managing editor. In 1912 he was appointed chairman of the editorial board of all the A. W. Shaw publications. He left Chicago in 1915 to join the McGraw Publishing Co. as editor of *Electrical World*. In the year following he established *Electrical Merchandising*, to supplement and extend the service of *Electrical World* to the industry. In 1919 he was made editorial director of the McGraw-Hill Co., and in January, 1920, was elected vice-president and chairman of the board of editors of its eleven publications.

Hearings on Townsend Bill Begin

Hearings on the Townsend highway bill began before the Senate committee on post offices and post roads May 13. George M. Graham of the highways committee, National Automobile Chamber of Commerce, urged the adoption of the Townsend bill principally on the ground that centralized supervision is essential to an efficient national highway system and because the greater number will benefit most by having primary interstate highways first. He declared that a federal commission, directly responsible to the President, is preferable to the bureau system for various reasons, among them being the fact that higher salaries can be paid under commissions. Since millions of dollars are to be expended on highways he argued that it would be the highest economy to pay higher salaries and secure as capable men as could be attracted to the work.

It is expected that the hearings will extend over a considerable period. One of the objects of these hearings is to build up a valuable record. Senator Townsend expects to exercise great care in developing all angles of the situation with the idea that the printed hearings will be an important contribution to the literature on highway development.

Stadium to Seat 85,000 Planned for Pasadena

Construction is to begin shortly on a stadium in the Arroyo Seco at Pasadena, Cal., about a mile above the Arroyo Seco concrete arch bridge and a short distance below Devil's Gate dam, which also crosses the arroyo. To make room for the stadium a new channel for the water course is to be provided along the east side of the arroyo and a dike will be thrown up to retain flood waters within the channel.

The stadium is to be built partly in excavation and partly on fill around an elliptical field with the south end left open. The diameters of the ellipse will be about 300 and 500 ft. Eighty tiers of seats are to be built along the sides and sixty tiers around the closed end. For the largest games temporary wooden seats are to be built across the open end, adding a seating capacity of about 15,000 and bringing the total seating capacity up to about 80,000.

The amount of material to be handled is estimated at 200,000 cu.yd. in the stadium and 125,000 cu.yd. in the dike. The cost of the structure complete is to be about $1,000,000 and the work is to be done in time for the big football game Jan. 1. Myron Hunt of Los Angeles is the architect.

Survey of Federal Departments Has Started

A thorough survey of the federal government's executive machinery has begun. The joint committee charged with the work met May 12 to organize and outline the work. President Harding was present.

Walter F. Brown of Toledo, Ohio, who is the executive representative of the committee, was elected chairman and Senator Smott, of Utah, vice-chairman. As soon as the survey of the departments has been completed public hearings will be held. The evidence gathered by the committee and that submitted by witnesses then will be studied and recommendations will be made which will cover, in addition to the subject of regrouping existing bureaus, the various proposals for new departments.

Extending Barge Canal Service

Operation of a number of deck-loading package freighters between Syracuse, Rochester, Buffalo and intermediate points along the New York State Barge Canal will be undertaken by the Merchants and Manufacturers' Transit Corporation of Rochester to provide a regular and frequent carload and less-than-carload merchandise service, according to announcement of Charles L. Cadle, superintendent of public works of New York State. The Syracuse-New York service will also be inaugurated, breaking bulk in Syracuse for local delivery and distribution to ports west of Syracuse. Eastbound shipments make bulk at Syracuse for delivery at New York. Alternate day sailings will be maintained to and from Buffalo and Syracuse and intermediate ports, except Rochester, where daily service will be provided. It is stated that the rates, including marine insurance, are 35 per cent less than rail rates. Through routes and joint rates will be maintained via canal and lake to Cleveland, Detroit, Chicago, Milwaukee, Duluth, St. Paul, and other Western ports. Agents will be stationed at canal terminal warehouses and freight will be accepted daily at all ports.

Commerce Dept. To Study Housing Problem

Secretary of Commerce Hoover has announced the appointment of seven engineers and architects on an advisory committee "to aid the department in solving the national housing problem." The men appointed are Ira H. Woolson, consulting engineer of the National Board of Fire Underwriters; Rudolph P. Miller, superintendent of buildings of Manhattan; J. R. Worcester, consulting engineer, Boston, Mass.; Prof. W. K. Hatt, of Purdue University; Ernest J. Russell, architect, St. Louis; Edwin H. Brown, architect, Minneapolis, Minn., and J. A. Newlin, of the Forest Products Laboratory, Madison, Wis. The committee will advise mainly on matters of building practice and not on the sociologic or city planning phases of housing.

In pursuance of the same idea a bill has been introduced in the Senate (S. 1152) authorizing the Secretary of Commerce to establish in the National Bureau of Standards a division to be known as the Division of Construction and Housing, the functions of which shall be to collect, classify, arrange and disseminate scientific, technical, practical and statistical information showing approved methods in building planning and construction and allied work.

Bill Creates Office of U. S. Civil Engineer

To improve the status of some of the assistant engineers in the United States Engineer Department who occupied responsible positions while officers in the Corps of Engineers were in war service, Senator Wolcott has introduced a bill (S. 1506) creating the office of United States civil engineer and providing for the pay and retirement of such officers. A part of the bill reads as follows:

"That all assistant engineers in the engineer department at large who at any time during the World War served as 'assistant engineers in charge' (district engineers) in engineer districts comprising river and harbor work, miscellaneous civil work, or fortification work, or as assistant engineer and secretary of the Board of Engineers for Rivers and Harbors, shall hereafter be designated as United States civil engineers; that their salaries shall be and the same are hereby fixed at not less than $5,000 per annum; and that they shall be retired in the same manner and under the same conditions as to disability, age, per centum of pay, and so forth, as are officers of the United States Army."

The bill also provides that these United States civil engineers are not to be liable to dismissal except for neglect of duty or malfeasance in office.

Kill Plan for Contract Cleaning of Philadelphia Streets

An attempt to amend the new charter of Philadelphia so as to make street cleaning in that city by contract again compulsory failed in the closing days of the recent session of the Philadelphia Legislature. Under the new Philadelphia charter, street cleaning, garbage collection and disposal, etc., must be done by the city itself unless the Mayor and Council decide in August of each year to have the work done by contract. A bill to amend the Philadelphia charter so as to change the word "may" in two sentences to the word "shall" made a rapid trip through the Senate, got entangled in the House in the course of a general factional political controversy, but finally was on its way toward passage when it was killed.

To Build Brooklyn-Staten Island Tunnel

By an act of the New York state legislature approved by Gov. Miller on May 12, the city of New York is directed to build a freight and passenger tunnel from Brooklyn to Staten Island. Construction must begin within two years, under the act. The work is to be done by the city Board of Estimate and Apportionment. A tunnel route from the southerly end of the Brooklyn Fourth Avenue rapid transit subway to Staten Island was laid out by the Public Service Commission a number of years ago but its construction has never been authorized. The present mandatory law takes the matter out of the hands of the Transit Commission.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Brooklyn (N. Y.) Engineers' Club, at its meeting May 26, will be addressed by one of its members on "Meters" from the standpoint of the city engineer, the legislator, the executive, the Lockwood Committee, the district attorney, and the public.

The Engineering Institute of Canada, Montreal Branch, at its annual meeting held May 5, elected J. H. Hunter chairman, and J. de Montrouge Duchastel, vice-chairman.

The Seattle (Wash.) Section, Am. Soc. C. E., held a dinner May 3 in honor of E. M. Chandler, former chief engineer, Washington State Reclamation Service, who has recently been appointed acting secretary of the American Society of Civil Engineers. There were addresses by E. B. Hussey, Joseph Jacobs and John L. Hall.

The International Association of Street Cleaning Officials will hold its annual conference at Chicago, Ill., August 10-12, at the Hotel La Salle.

PERSONAL NOTES

W. A. DUFF, formerly assistant chief engineer, Moncton division, Canadian National Rys., has been appointed engineer of standards, with headquarters at Toronto.

LANG & ROSS, surveyors and civil engineers, Sault Ste. Marie, Ont., have been appointed as engineers to the townships of MacDonald and Meredith, Algoma District, Ont.

B. G. MICHEL has resigned as city engineer of Kitchener, Ont., to enter business as a road contractor.

FRANK N. RUTHERFORD, of St. Catharines, Ont., engineer of Lincoln County, has been appointed road superintendent of Lincoln County Ont., succeeding Peter Robertson, resigned.

J. L. WELLER, formerly chief engineer of the Welland Ship Canal and during the last two years of the war engaged in advisory work in connection with concrete shipbuilding in the United States, has entered private practice in Hamilton, Ont., specializing in canals, harbors, docks, dry-docks, dams, hydro-electric developments and foundations.

H. G. BAILEY has been engaged as highway engineer of Henderson County, N. C.

JOHN B. FIK has been appointed city engineer of Muskegon, Mich.

G. N. HOUSTON, formerly acting commissioner of irrigation in the reclamation branch, Department of the Interior, Canada, has accepted a position as head of the provincial irrigation work with the Alberta government.

W. C. JEPSON, recently in private engineering practice in the Niagara peninsula, has been appointed city engineer of Niagara Falls, Ont.

J. B. MCKEE has been appointed city engineer of Plattsmouth, Neb.

W. H. HOUSER has been appointed city engineer of Blue Springs, Neb.

B. A. DOCKERY has been appointed county engineer of Grundy County, Missouri, with headquarters at Trenton.

CLARENCE E. SHRIVER, formerly special engineer for the Tallassee Power Co., Badin, N. C., in connection with street layouts on sidewalk and drainage work, also water filtration, sewage disposal plants and systems, is now with the Kentucky State Highway Department.

CHARLES SCHULTZ has been appointed city engineer of McKinney, Tex.

WILLIAM J. DWYER has been appointed county superintendent of highways of Cortland County, N. Y.

J. R. SEXTON, regional engineer of the Erie R.R., with headquarters at Chicago, Ill., has been appointed division engineer, with headquarters at Huntington, Ind.

H. D. HERBERT has been elected borough manager of Carlisle, Pa.

WALTER A. SHAW, for oven seven years engineering member of the Public Utilities Commission of Illinois, has reentered private practice as a consulting engineer, with offices at Chicago, Ill. He will give attention to public utility rate cases, reports for banks and investors, public utility and industrial management, operation and construction, and all branches of municipal engineering and construction work, including designing and supervision.

D. B. STEINMAN, formerly special assistant to Gustav Lindenthal, consulting engineer, New York, and later professor in charge of civil and mechanical engineering at the College of the City of New York, has opened an office in New York City to make a specialty of service to engineers and architects in designs, estimates, structural problems, inspection, appraisals, research, reports, etc.

JOHN M. RICE has established offices at Pittsburgh, Pa., to engage in private engineering practice. His experience covers the design, construction and operation of allotments and real estate developments, industrial housing developments, streets and highways, power plants, water distribution systems, sewage treatment and disposal works, etc., and the preparation of reports and expert testimony in these subjects.

H. SCHANTL, formerly engineer maintenance of way with the Mississippi River & Bonne Terre Ry., has been appointed chief engineer of the Missouri-Illinois with headquarters at Bonne Terre, Mo.

GUY C. DUNN, formerly engineer of construction Grand Trunk Pacific Ry., with headquarters at Winnipeg, Man., and since December, 1920, office engineer chief engineer's office, Eastern Lines, Canadian Northern Ry., has been appointed assistant to chief engineer Eastern Lines, Canadian National Rys., with headquarters at Toronto.

JOHN KAINES has been appointed superintendent of highways of the Onondaga Indian Reservation by the New York State Highway Department.

STANLEY SHUPE of Ottawa, has been appointed city engineer of Kitchener, Ont.

GEORGE C. WRIGHT, for eleven years connected with the Monroe County, N. Y., engineer's office and since 1914 deputy county superintendent of highways, has been appointed county superintendent of highways of Monroe County.

WILLIAM T. CROWLEY, formerly construction superintendent with the Foundation Co., has been appointed city engineer of Lock Haven, Pa.

H. E. ANSCHUTZ, formerly with the Georgia Highway Department, has been appointed engineer of the city planning commission of Atlanta, Ga.

E. G. HUNT, civil engineer, has been appointed city engineer of Aberdeen, Wash.

OBITUARY

ELIOT C. CLARKE, civil engineer, died in Boston, Mass., May 4. He was born in Boston in 1845 and was graduated from Harvard University, 1867. In 1868 he was engaged as civil engineer on a bridge then building over the Mississippi River at Quincy, Ill. Among other works with which he was connected were the bridge over the Mississippi at Hannibal, Mo., the Detroit River tunnel, Chicago water-works tunnel and the Chicago sewerage system. In 1876 he was appointed engineer in charge of a survey for a main drainage system for Boston. In 1884 he became chief engineer of the Massachusetts Drainage Commission, created to design methods of preventing pollution of the Charles, Mystic and Blackstone river basins. In 1886 he was associated with James B. Francis and Clemens Herschel in a study of the floods of Stony Brook, Boston. The report of this commission is still considered of great significance in study of flood control problems. From 1886 to 1904 he managed mill properties at Lowell and in 1904 retired to manage his private affairs with an office in Boston, Mass. He was the author of "Astronomy from a Dipper," an account of the Main Drainage Works of the City of Boston, a Report of the Commission to Consider a General System of Drainage for the Valleys of Mystic, Blackstone and Charles Rivers, and contributions to engineering journals.

MAJOR-GENERAL FRANCIS V. GREENE, police commissioner of New York under Mayor Low in 1903, and from 1904 to 1915 president of the Niagara, Lockport & Ontario Power Co., died May 15 in New York City. He was born in Providence, R. I., in 1850 and after graduation from the United States Military Academy at West Point in 1870 he entered the Corps of Engineeres, U. S. A. In 1876 he was assigned to special duty in the office of the Secretary of War in Washington, and in June, 1877, was sent abroad by the government to witness and report upon the military operations during the war between Russia and Turkey. In 1879 he was appointed assistant to the engineer commissioner at Washington, D. C., where he served six years. Shortly thereafter he resigned from the army. In 1901 he was elected president of the Barber Asphalt Paving Co. From 1903 to 1904 he was police commissioner of New York City and from 1904 to 1915 he was president of the Niagara, Lockport & Ontario Power Co., and vice-president of the Ontario Power Co. of Niagara Falls. He retired in 1915 on account of failing health and made his home in New York City.

Business Side of Construction

Facts and Events that Affect Cost and Volume

The Wage Situation in the Building Industry

Attempts have been made during the past few weeks in various cities suffering from building trade strikes to arbitrate wage disputes though little has has been acomplished in the way of arbitrating the difficulties so far. Another feature of the wage situation is the tendency of building contractors to turn to open-shop methods of operation as an answer to the flat denials from unions that they will not accept wage cuts.

Employers and employees in the building industry in Philadelphia are practically deadlocked, though there has been a considerable quickening of small alteration and repair jobs in the building trades. This condition is attributable, it is presumed, to the fact that many of the union carpenters and other mechanics out of employment are seeking so-called one-man development jobs to keep employed. During the past week the building department of the Philadelphia Department of Public Works issued the largest number of building permits for one day in the history of the department.

In Cleveland, attempts are being made to arbitrate the question of wages. Both employers and employees are standing firm in their respective views as to the justice and need of a wage decrease. Recently the Cleveland Builders' Exchange took out strike insurance to the extent of $1,000,000.

Arbitration proceedings are also reported in progress in Indianapolis, New Haven, Conn., and in Syracuse, N. Y., though success in adjusting the difficulties has not yet been attained. Along with the talk of arbitration proceedings in Kansas City, there is also some comment to the effect that a federal investigation is not impossible.

Practically all the building trades are out in Westchester County, New York, and all efforts to effect an agreement have so far failed. In Tulsa, Okla., wage reductions ranging from 10 to 20 per cent have been proposed by the employers association. In Toledo, Ohio, the builders are standing firm for a material decrease and in Minneapolis, where a 20 per cent decrease was proposed by the employers, certain trades are considering a smaller reduction, the bricklayers voting to accept a 10 per cent decrease, though strongly asserting that a 20 per cent decrease was too much.

The carpenters of Worcester, Mass., have voted to accept a 15 per cent decrease and it is thought that their action may have some effect upon other building trade mechanics who have been on strike for some time.

The 2,000 metal workers of New Orleans, employed in foundries, machine shops, and big repair plants, who have been on strike for sixty days, have resumed work. They accepted the wage cut of their employers, to 80 cents for mechanics and from 50 to 60 cents per hour for helpers.

Mason Building Material Dealers Fined a Total of $74,000

Though Special Deputy Attorney General William A. de Ford had recommended that heavy jail sentences be imposed on the members and corporations of the Association of Dealers in Mason Building Materials who pleaded guilty to conspiracy in restraint of trade following investigations made by the Lockwood joint legislative committee on housing, the nineteen individuals and fourteen corporations involved were fined May 16 by Justice Davis of the New York Supreme Court.

The individuals were fined $500 each, the fines of the corporations ranging from $2,000 to $7,500. The total penalty imposed on the individuals and corporations amounted to $74,000.

Freight Rates on Principal Building Materials

Comparison Given Between Shipping Cost and Cost to Contractor—Rates Irregular

Included in the accompanying table are the freight rates on the principal building materials and on coal from producing regions to centers of consumption. An analysis of these rates in connection with current quotations of the materials shows not only the lack of uniformity in per-mile charges for like materials shipped over different railroads, but also the presence of prohibitive charges in some localities. Evidently, in such instances, the rate operates in favor of other producing centers, or the transportation and handling difficulties are large. The table also shows that the freight rates of 1917 and 1920, expressed in per cent of materials prices, are not far apart.

It may be seen too, that, for instance, the rate on sand from Patapsco, Md., to Baltimore, and on sand and gravel from Peekskill to New York are in excess of the current market quotations for those materials, indicating tha

COMPARISON OF PAST AND CURRENT FREIGHT RATES ON BUILDING MATERIALS AND COAL FROM PRODUCING TO CONSUMING CENTERS

Material	From	To	Miles	Rates in Effect Jan. 1, 1917	Rates in Effect Aug. 20, 1920	Rates in Effect Jan. 1, 1921	Current Prices of Materials	Current Rates in Per Cent of Material Prices	Material Prices As of Jan. 26, 1917	Jan. 1 1917 Rates in Per Cent of 1917 Material Prices
Cement, per bbl.	Ragland, Ala.	Atlanta	119	$0 29	$0 37	$0 48	$2 75	17	....	..
	Union Bridge, Md.	Baltimore	108	17	29	41	....	..	....	..
	Hudson, N. Y.	Boston	193		48	58	2 86	20	....	..
	Sandusky, O.	Chicago	281	29	41	56	2 17	23	$1 96	15
	Hudson, N. Y.	N. Y. C.	113	20	32	47	2 90	16	2 07	10
Brick, per 1,000	Chattahooche, Ga.	Atlanta	8	45	1 65	1 65	12 00	14	....	..
	Waterloo, Va.	Baltimore	46	1 92	3 30	4 67	22 50	21	....	..
	E. Bridgewater, Mass.	Boston	25	1 92	3 30	4 67	21 75	22	....	..
	Danville, Ill.	Chicago	129	2 58	3 30	4 67	12 00	39	6 00	43
	West Haverstraw, N. J.	New York	33	2 31	3 85	5 50	18 40	30	9 50	24
Gravel, per ton	Conkey, Ga.	Atlanta	10	20	50	62	2 62	24	....	..
	Patapsco, Md.	Baltimore	17	53	80	1 10	1 40	78	....	..
	Canton, Mass.	Boston	14	35	60	80	2 65	30	....	..
	Rupel Pit, Ind.	Chicago	91	39	55	77	1 83	42	93	42
	Peekskill, N. Y.	New York	40	1 26	1 80	2 50	1 67	150	74	170
Lime, per ton	Calera, Ala.	Atlanta	175	1 20	1 50	1 87	15 00	12	....	..
	York, Pa.	Baltimore	65	95	1 40	1 96	17 50	11	....	..
	Pownal, Vt.	Boston	151	2 20	3 00	4 20	22 75	18	....	..
	Genoa, Ohio	Chicago	246	2 10	2 70	3 80	20 00[1]	19	....	..
	Ossining, N. Y.	New York	30	1 16	1 60	2 20	20 00	11	....	..
Sand, per ton	Dames Ferry, Ga.	Atlanta	72	30	50	62	1 52	41	....	..
	Patapsco, Md.	Baltimore	17	53	80	1 10	70	157	....	..
	Sharon Heights, Mass.	Boston	18	30	90	1 30	2 00	65	....	..
	Rupel Pit, Ind.	Chicago	91	39	55	77	2 04	38	67	58
	Peekskill, N. Y.	New York	40	1 26	1 80	2 50	.93	269	33	380
Coal, per ton	Excelsior Colliery, Pa.	Atlanta	708	4 12	5 62	7 04	....	..	....	..
	Schuylkill Region	Baltimore	163	1 43	1 87	2 62	....	..	....	..
	Mayfield, Pa.	Boston	347	2 37	2 85	4 00	....	..	....	..
	Buffalo, N. Y.	Chicago	522	1 56	1 92	2 68	....	..	....	..
	Lehigh Region	New York	291	1 61	2 05	2 87	....	..	....	..
Lumber[2], per M. ft.b.m.	Tallapoosa, Ga.	Atlanta	63	1 44	1 80	2 25	27 50	8	....	..
	Waycross, Ga.	Baltimore	771	8 40	10 50	14 00	60 00	23	....	..
	Allenhurst, Ga.	Boston	1,123	10 85	11 90	15 92	45 00	35	....	..
	Atlanta, Ga.	Chicago	784	7 70	10 32	13 82	51 00	27	27	28
	Savannah, Ga.	New York	880	8 75	10 85	14 52	37 00	39	29	30

[1]—Finished Lime in Chicago; [2]—All lumber white pine; [3]—Including bags, not delivered.

Patapsco supplies no sand to Baltimore and Peekskill neither sand nor gravel to New York. The rate therefore operates to prohibit the shipment of those materials to Baltimore and New York.

The information included in the accompanying table is taken from data collected by the U. S. Senate committee on reconstruction and production at hearings held throughout the country early in the year. The producing centers are those lying nearest points of consumption, giving the shortest rail haul. It is not, however, generally true, that the producing centers here given actually furnish the bulk of the materials indicated to the cities given, but merely show the trend of rates.

While the rates given in each case are for only one haul, it should be remembered that the proportion of transshipments for these materials, being in carload lots, is small. No account is taken in the table of less-than-carload lots, as such movement of building materials is small.

The current prices of materials are usually the prices delivered to the contractor. In the case of cement the quotations are prices per barrel in carload lots with the exception of Baltimore, where the price is that per barrel in drayload lots. The per barrel price in carload lots would be around $1 per barrel less. The quotations on sand and gravel are per ton in carload lots, the usual per-cubic-yard quotation in New York and Chicago being adjusted to a per-ton basis for the purposes of comparison. Quotations on lime are warehouse prices per ton for common lime, except in the case of Chicago as noted in the table. Brick is quoted per thousand, in carload or cargo lots delivered, except in Chicago and Atlanta, where the quotation is for brick not delivered. White pine is quoted in M. ft. b.m., on pieces 8 x 8 in., 20 ft. and under. The shipping rate on lumber was determined by referring to the weight per M. ft. b.m. on air-dried lumber as compiled by the U. S. Forest Service.

What Table Shows

As indicative of what the table shows the freight rate per barrel on cement now ranges from 41 cents for a 108-mile haul to 58 cents for a 193-mile haul, though a haul of an even greater distance—281 miles—is only 56 cents. Local shipping conditions might explain such a discrepancy. The rate on cement, expressed in a ratio to the current prices of cement in the various cities, ranges from 16 to 23 per cent.

Then, in comparing the ratios of freight rates for 1917 and 1921 with the costs of materials it is found that in 1917 freight represented 43 per cent of the cost of brick in Chicago, and 24 per cent in New York, whereas now these figures are 39 and 30 per cent, respectively. For lumber freight represented 28 per cent of the cost in 1917 in Chicago and 30 per cent in New York, and 27 per cent in Chicago now and 39 per cent in New York. Comparisons in cement between the two years cannot well be made, the 1917 quotation including bags and not delivered, the 1921 price being delivered and without bags.

As the table gives a fair idea of the rates on all materials it is left to the engineer and contractor to determine whether the rates on building materials are too high, as compared with the current costs of these materials.

Construction Articles in This Issue

Long Arch Bridge Built of Slag Concrete Page 840

Personnel Board Keeps Tab on Contractor's Field Forces Page 860

Felling Four Steel Chimneys Lined Outside with Concrete Page 855

Construction Industry Conference Proceedings Issued

The proceedings of the Philadelphia and the national conferences of the construction industry held Feb. 15-18 and March 2 and 3, respectively, has been issued. The Philadelphia conference was held under the auspices of the industrial relations committee of the Philadelphia Chamber of Commerce and the national conference was held in Chicago under the auspices of the National Federation of Construction Industries. Both of these meetings are reported in *Engineering News-Record*, the first in the issue of Feb. 24, p. 361, and the national conference in the issue of March 10, p. 447.

Production of Southern Pine

For the week ending May 6 the production of 132 mills reporting to the Southern Pine Association amounted to approximately 69,000,000 ft. b.m., or 77 per cent of the normal cut. The orders for the week were 75,000,000 ft. b.m. and shipment about 76,000,000 ft. b.m. This indicates that orders were 84 per cent of normal production and shipments 85 per cent.

Many Bank Buildings Being Erected

Hoggson Bros., the New York and Chicago builders who specialize in bank design and construction, report that during the period from Jan. 1 to April 1, they completed work on nine bank buildings, in New York City, Wyoming, Kansas, Pennsylvania, Illinois and Michigan. This is a three months' record for completed contracts. During the first three months of 1920 but one bank building was completed and for the first three months of 1919 only five. Five also was the average number of buildings built for any three months' period over the two years previous to Jan. 1, 1921.

Portland Public Utility Plans Extensions

The Portland (Ore.) Railway, Light & Power Co. is planning to spend approximately $2,000,000 in and near Portland in the near future, according to a statement recently made by the company. The money will be expended for the most part in the installation of a new steam turbine to cost $400,000; the rebuilding of a bridge, $150,000; overhead construction and extensions in the light and power department, $250,000; reconstruction of tracks and repaving, $260,000; bridges, buildings and maintenance wrok, $150,000, and maintenance-of-way work on Portland city lines, $350,000. The company recently sold $1,000,000 in gold notes to aid in this repair and extension work.

South African Railway Bids Will Be Received Until July 5

Bids for the electrification of the Cape Town-Simontown and the Durban-Maritzburg railway lines will be received up to July 5 by the office of the high commissioner for the Union of South Africa, London. Bids were asked on this electrification project previously, as noted in *Engineering News-Record*, May 5, advertising page 88, but an extension of time has been granted for the submission of bids.

Ogden to Build Outfall Sewer

Bids are soon to be advertised for the construction of a main outfall sewer for the city of Ogden, Utah. Plans and specifications for the work have been prepared and as the preliminary notice to contractors states (see this issue advertising page 62) the principal items of the work will include 10,500 lin.ft. of 42-in. sewer pipe, 2,900 lin.ft. 48-in. pipe and 16,000 lin.ft. of 60-in. pipe, in additon to excavation and back filling to the amount of 120,000 cu.yd.

Indiana State Building Close to $2,000,000

Summary of the building operations provided for by the Indiana legislature just ended and to be carried out by the McCray administration discloses nearly $2,000,000 of projects. The operations are to be spread over most of the four-year term of the administration. The proposed improvements include extensions to state insane asylum, the construction of a children's hospital, a state normal school branch, and a reformatory.

Sewage Disposal Project for Oklahoma City

Sewage works including settling tanks and sprinkling filters, as recommended for Oklahoma City, Okla., by Pearse, Greeley & Hansen, consulting engineers, Chicago, have been approved by the sewage board and the project is

now before the city commissioners. These works are necessary to comply with an order issued by the state board of health in November, 1920, requiring the discharge of sewage into the rivers to be stopped before the end of 1922. Two plants are recommended, both for domestic sewage only, the treatment of packing house sewage to be worked out later. The esimated cost is $185,000 for the former and $1,810,000 for the latter, or $2,560,000 for the latter with combined domestic and industrial sewage. For this purpose a bond issue of $2,000,000 is recommended.

Idaho Dam to Cost $1,200,000

Construction work will be started early this summer by the Emmett Irrigation District on the Black Canyon dam, 5 miles up the Payette River, from Emmett, Idaho, to be built at an estimated cost of $1,200,000. Power to lift water 30 ft. for the district will be generated in the dam. The water will be lifted by electrical power into the higher level canal of the Emmett Irrigation district, eliminating some 16 to 18 miles of side canal in the present system. Water will be supplied to the Black Canyon project through a lower level canal, involving the construction of 20 to 30 miles of canal. The dam will be of the gravity arch type.

Gold Imports and Exports for 1920 and 1921

According to a recent bulletin issued by the Department of Commerce the gold exports of the ten months ending in April amounted to $132,000,000, whereas the imports totaled $568,000,000. During the corresponding period of 1920 the exports were $454,000,000 and the imports $108,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$4.50	$3.23	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	49%	50 65–5%	45%	58½%	51 9–5%	29%	49 80	45%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.00	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80 (del.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	4.00	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	2.75	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	40.00	50.00	55.00	38.00	47.00	27.00	25.50@28.50	120.00
Lime, finished, hydrated, ton	21.00	22.50	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	3.00	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	16.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	.10	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	....	.15	.13	.096	.10	.10	.14½	.12	....
Linseed oil, raw, 5 bbl. lots, gal	.73	.66	.85	.82	.83	.90	.93	.79	.72
Common Labor:									
Common labor, union, hour	.75@.80	.35	.35@.45	1.00	.50	.50@.63½	.81¼	.75	....
Common labor, non-union, hour	....	.25	.35@.45	.40@.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Gravel, sand and brick are quoted delivered, crushed stone f.o.b. cars. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

New York dealers have cut prices on cement until that material is hardly profitable to handle. On April 28 we announced the decrease from $3.10 to $2.90, and stated that the dealers were figuring a profit of only 4c. per bbl. The price has now been lowered to $2.80 without bags, delivered on the job. When it is considered that the manufacturers' price to dealers is $2.40 alongside and that unloading, cartage and handling in the yard cost 46c., it will be apparent that the dealer is on the wrong side of the ledger by 6c. per bbl. In fact his only chance of preventing a loss is to discount his bills. No cut has been announced by manufacturers.

Lumber is stronger in Atlanta, Dallas and Seattle, but down $3 per M. ft. b.m. in New York. Rivets are down 65c. in San Francisco, to $6.40 per 100 lb. Sand is off 15c. in San Francisco. Linseed oil is up 3c. per gal. in New York and 1c. in San Francisco.

As to labor—the latest report from Chicago is that the unions and the contractors' organization are to resume parleys with a view to settling the strike. Common labor demands a continuation of the $1 rate, but the contractors' offer is 65 to 75c. per hour. Non-union common labor is paid 40 to 50c. per hour.

Minneapolis unions and building crafts still refuse the 20 per cent cut that was announced by the contractors effective May 1. There will be a joint conference on the issue this week. Meanwhile, employers claim that sufficient labor is available at the new scale, while the union spokesmen maintain that in most cases where union men are being employed, the old scale is being paid.